Engineering News-Record

Twenty-five cents, five dollars per year McGraw-Hill Publishing Company, Inc.

July 27, 1933

Blasting Rock at Golden Gate Bridge Pier Sites

•

Timber Bridge Trusses With Joints of Ring-Connector Type

•

New Activated-Sludge Plant for Milwaukee

•

Handling Extra-Work Orders on Building Work

•

Lining Hetch Hetchy Coast Range Tunnel

•

Increasing Flume Capacity by Improved Transition

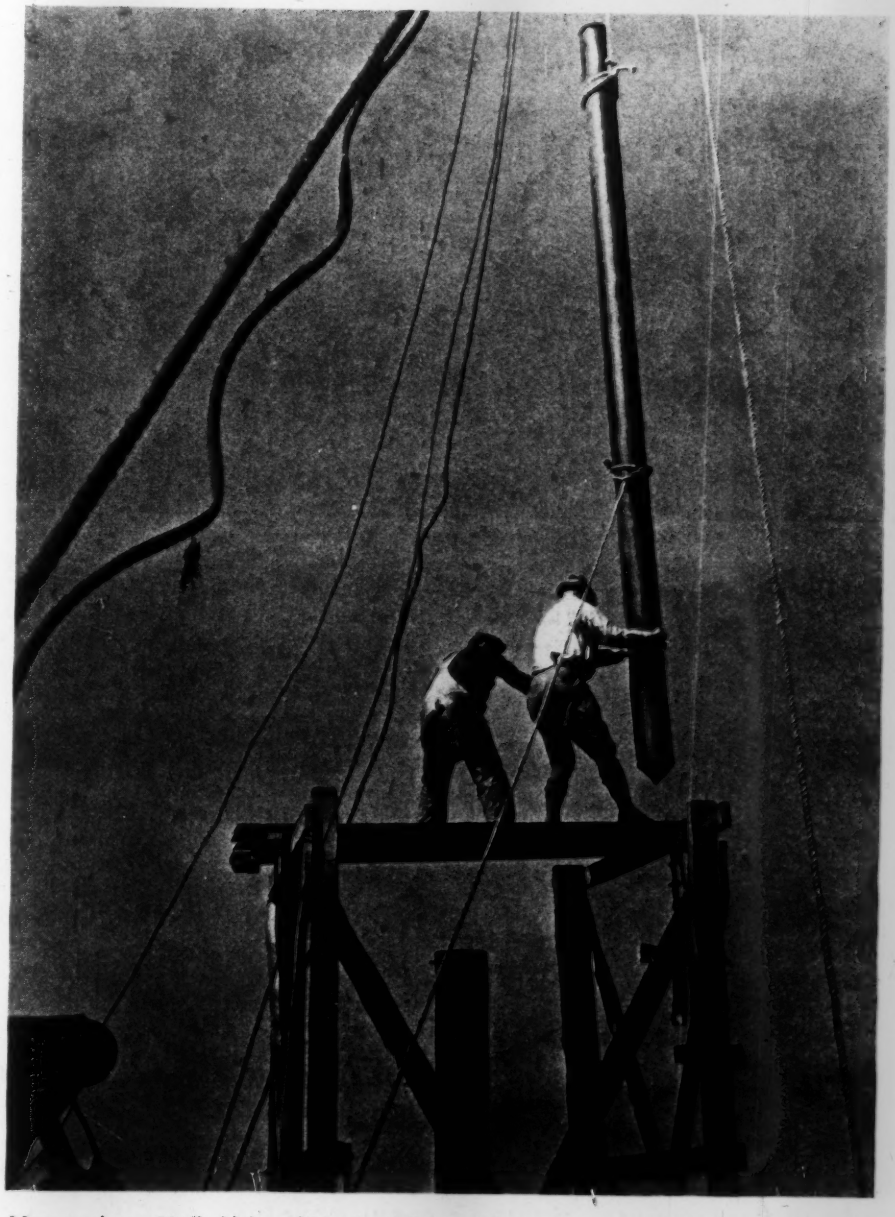
•

Administrative Units for Local Roads

•

Developing the Atchafalaya Floodway

Sixth Article on New Plans for the Mississippi



Maneuvering a 250-lb. high-explosive bomb into position to drop through the 14-in. pipe to the rock bottom of the Golden Gate. Explosion of a series of these bombs placed on 20-ft. centers will shatter 30,000 cu.yd. of rock at the San Francisco pier site of the new 4,200-ft. span suspension bridge. The rock will be removed by clamshell dredges.

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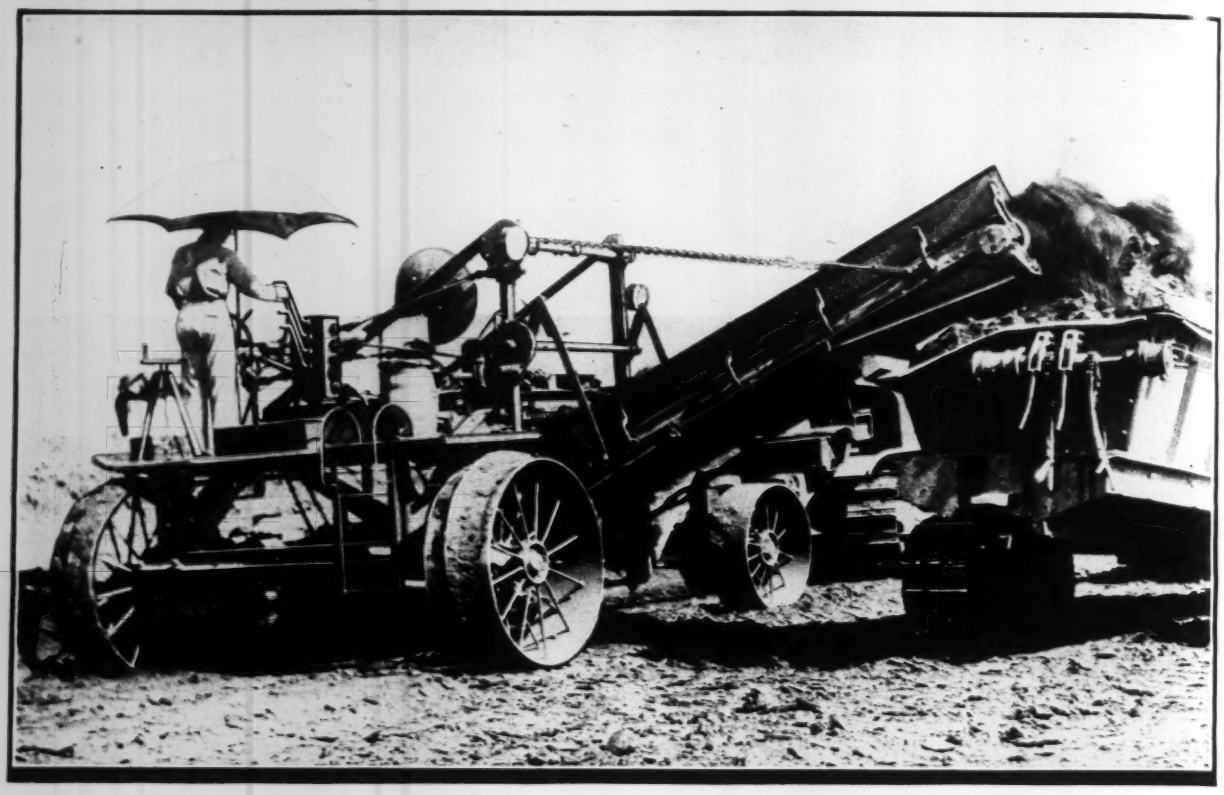

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Published every Thursday. Price 25c. per copy. Subscription, domestic, Central and South America, $5 per year. Canada, including duty, $7.50. Foreign $9 or 45 shillings. Entered as second-class matter April 11, 1917, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A. Cable Address "MCGRAWHILL, New York." Member A.B.P. Member A.B.C.

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42D STREET, NEW YORK, N. Y.

Editorial and Publishing Offices: 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C. James H. McGraw, Chairman of the Board; Malcolm Muir, President; James H. McGraw, Jr., Vice-President and Treasurer; Mason Britton, Vice-President; Edgar Kobak, Vice-President; H. C. Parmelee, Vice-President; Harold W. McGraw, Vice-President; B. R. Putnam, Secretary.

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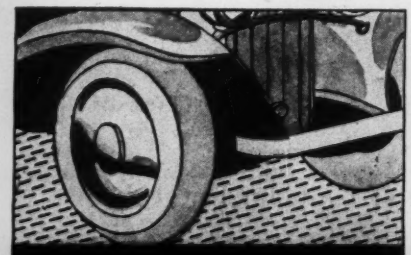

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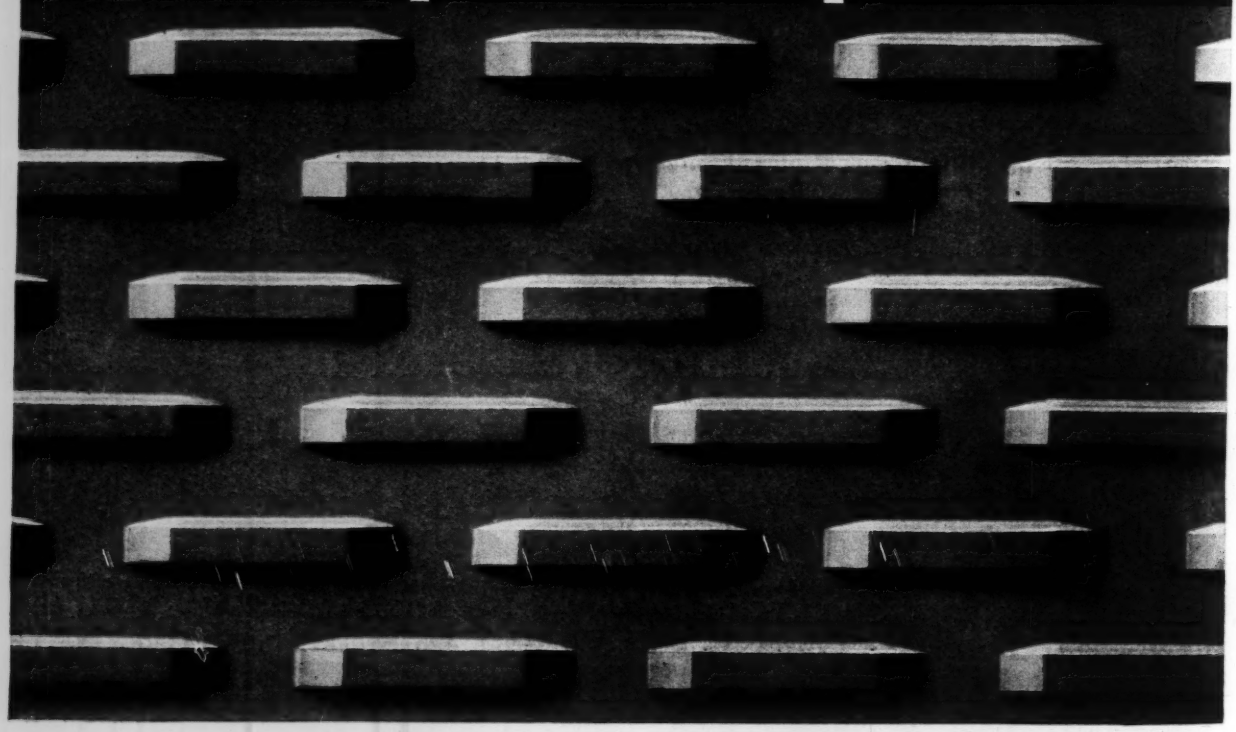

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Bombing Out Subaqueous Rock at Golden Gate Bridge Pier

Small bombs dropped against rock prepare 15-ft. hole for 250-lb. bombs—Holes spaced 20 ft. apart—Shattered rock removed by clamshell derrick on barge—Extensive excavation by pneumatic process eliminated

SUBAQUEOUS blasting operations to remove 30,000 cu.yd. of rock to a depth of 100 ft. below water surface at the San Francisco pier site of the Golden Gate Bridge have developed a unique procedure. Without using ordinary drilling operations, small high-explosive bombs are dropped against the surface of the rock through a steel tube and exploded in succession until the rock has been shattered to a depth of about 15 ft. Next a large-size bomb containing about 250 lb. of high explosives is driven to the bottom of this hole and exploded. These holes are spaced at about 20-ft. intervals over the pier site, and they shatter the rock, which is removed by clamshell dredge on a barge and overcast into deep water. Operations have already carried the excavation to El. —85, and the program calls for completion by August. General progress on this project was outlined in our issue of July 6, p. 7. The details of the blasting operations are described in the following.

The site of the San Francisco (south) main pier of the Golden Gate Bridge is located about 1,000 ft. from the shore line in a depth of water ranging from 50 to 80 ft. There is no loose material overlying the rock, as the tidal movement (which approaches a velocity of 6 m.p.h.) keeps the rock swept clean. The foundation material is a serpentine formation, and plans call for seating the fender and pier at El. —100. Specifications require the pier caisson to be sunk by the pneumatic process within the protection of the fender system previously constructed. The method of removing the rock to foundation level was left up to the contractor. The plan for excavating the entire fender and pier site to the final elevation by subaqueous blasting and excavation was proposed by the contractor and accepted by the district.

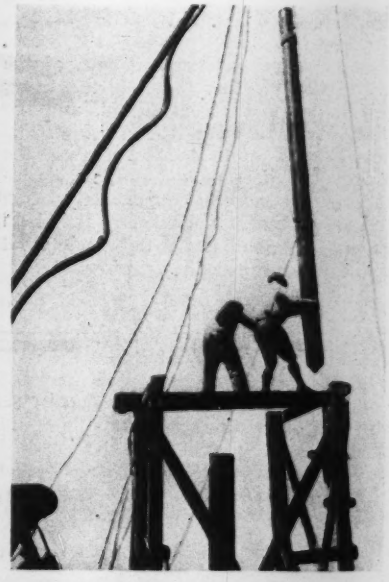


Fig. 1—Maneuvering one of the large bombs, suspended on a lead line from the derrick, into the top of the barrel. It is allowed to fall free to the hole shattered by the small bombs and is then driven until the lower end is 15 to 18 ft. below rock surface. Exploding these large bombs breaks up the rock so that it can be removed by a clamshell dredge.

The first requirement was to construct a 1,000-ft. pile trestle (Fig. 2) from the shore to the pier site. The blasting operations used for putting down these piles were similar to the work for the pier and are described later. At the end of this trestle, which was provided with a 10-ft.-gage track for an electric crane, the work at the site was carried on from a 42x140-ft. barge. The barge is a self-contained unit with derricks, complete hoisting equipment and winches to operate six anchor lines. The barge is held and maneuvered by means of the six 1¼-in. anchor cables attached to 5-ton anchors with 600 ft. of anchor chain, adding 6 tons of weight. The tide and swells in this narrow entrance to San Francisco Bay make all operations from the barge difficult, but in spite of vertical surges of as much as 10 ft. there has been no shutdown in excavation work as a result of weather. The average crew

Fig. 2—A 1,000-ft. trestle was required to reach the site of the San Francisco (south) pier. Note the timber pile and steel column foundation set into rock by the bombing method. The north pier site is in the shadow of the cliff just to the left of the derrick boom.

on the barge is about six men, and three-shifts are worked.

Bombing the holes

The first step in the blasting process is to lower a 14-in.-diameter steel pipe, or bombing barrel, to rock surface. This pipe extends about 20 ft. above the deck of the barge. To provide weight and strength, a heavy steel casting is added to the lower end of the barrel with two steel legs at 45-deg. angles to maintain the lower end about 10 ft. above the rock surface. The sharp ends of these legs gradually work sockets in the rock and hold the barrel in position. The upper end of the barrel is supported by a collar at the end of the barge, which allows for vertical surge of the vessel. With this barrel in position, preparations are complete for bombing the hole.

A section of 8-in.-diameter steel shafting 20 ft. long is slung from the end of a line on the boom of the barge derrick in a position for sliding down the barrel. The lower end of this 5,000-lb. weight bar is fitted with a 2½-in.-diameter steel point 2½ ft. long, and this drop-hammer arrangement is used to start a hole about 2 ft. deep. The point is then removed and replaced by a chuck to hold the bombs.

The bombs (Fig. 3) consist of a 2½-ft. length of 2½-in. diameter seamless steel tubing ¼ in. thick, with a tool-steel conical point welded to the end and loaded with from 2 to 3 lb. of 60 per cent special powder. This explosive has been developed expressly for this use. A ⅜-in.-diameter iron pipe extends within the shell from the powder to near the top of the bomb. At the upper end of this pipe is placed the cap and firing pin, which extends about ¾ in. beyond the end of the bomb. The remainder of the bomb is filled with concrete. To explode the cap, the pin must be driven down flush with the end of the bomb and, since this requires driving two lugs down the inside of a brass tube, an extremely heavy blow is needed. The time fuse that burns inside the ⅜-in. pipe is set to explode the charge after a delay of about 60 sec. These bombs are loaded and taken to the barge in cases holding 100.

The chuck on the end of the weight bar, which receives the end of the bomb, has two slots to engage lead lugs on the end of the bomb. A quarter of a turn seats the bomb in the chuck, leaving a clearance of ¼ in. between the end of the chuck and the end of the firing pin. With the dropping of the weight, the two lead lugs shear off and the end of the chuck drives in the firing pin, followed by the entire weight of the 5,000-lb. shaft dropping 60 to 80 ft. and driving the bomb into the rock.

The weight bar is raised and held in position by a key across the top of the barrel while the bomb is inserted in the chuck through a hole in the side of the barrel (Fig. 4). This work is done by men on a timber platform at the end of the barge. With the bomb in position, the key is removed to drop the bomb-tipped weight the entire length of the barrel; on striking the rock the firing pin is touched off as stated, and the bomb is embedded to its full length. The derrick operator then redraws the weight bar until a mark on the cable indicates that its end is immediately below the lower end of the barrel. It is held in this position for the minute interval until the explosion has taken place.

This maneuver is a safety precaution. If for any reason the bomb does not release from the end of the shaft it will explode into the water between the rock and the bottom of the barrel and not damage the barrel or endanger the barge. After the explosion at the end of the 1-min. interval, the shaft is withdrawn and another bomb placed in the chuck. Under ordinary operations these bombs can be exploded at about 2-min. intervals.

The penetration obtained by each bomb varies considerably, depending on whether it is the first hole of a lift of rock or one driven after several large bombs have been exploded. Of course the type of rock is an additional factor. With the serpentine formation encountered at the site, the 15-ft. depth of hole has been sunk with 7 to 25 bombs. The first hole of the lift usually requires about 25 bombs, but after the rock has been shattered by previous large bombs the holes are put down with seven to ten bombs. The effect of the bomb is not so much to excavate a hole as to shatter and soften an area of rock into which the large-size bomb can be driven.

Following the blasting of a hole to a depth of 15 ft. or less, depending on the rock's contours, the weight is withdrawn from the barrel. A 9-in. diameter bomb loaded with about 250 lb. of explosive is next dropped through the barrel (Fig. 1) into the hole and driven to the bottom by a length of 10-in. shafting as a drop-hammer. This bomb is of seamless steel tubing 20 ft. long with a welded point. The powder containers are grouted into the bomb, covered with 3 ft. of concrete and capped with a 6-in. layer of asphalt to keep out the water. The firing line is coiled in the upper

Fig. 3—Two of the small bombs of ¼-in.-thick tubing containing 2 or 3 lb. of explosive. These are driven successively into the rock through the barrel to blast a hole for the larger bomb.

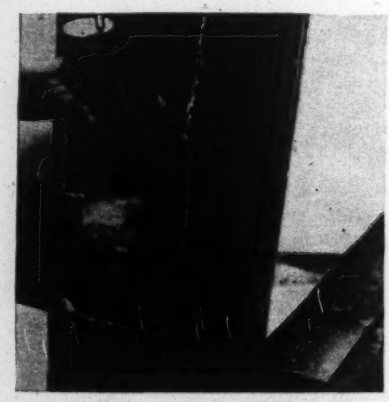


Fig. 4—Fitting the bomb into the chuck on the end of the weight bar through a hole in the side of the barrel. This operation is done from the platform on the end of the barge. The steel wearing plate, at the right, is part of the collar permitting movement of the barge.

part of the bomb and is subsequently brought to the surface by divers for firing. In come cases the 9-in. bomb shells have been driven empty, and later the powder charges have been placed by divers.

After the large bomb has been driven, the barrel is raised and the barge is maneuvered to the next location with the anchor lines. The usual distance provides a 20-ft. spacing. Holes are staggered at each lift to take down any ridges. After six holes have been loaded, the barge is removed about 300 ft. from the site, the firing lines are brought to the surface, and all six charges are exploded at once. The effect of such a blast in a depth of about 60 ft. of water with 20 ft. of rock overburden is a heavy preliminary jolt followed by the rising of the gases, which lifts the water surface about 3 or 4 ft. over a large area.

Dredging operations that follow the blasting of rock indicate that the material has been well shattered, and there is no difficulty in removing it effectively with a 4-yd. clamshell bucket operating from the barge. The excavated material is merely overcast into deeper water where the depth and the swiftness of the current dispose of it.

In building the timber and steel pile trestle 1,000 ft. out to the pier site, the same general method of bombing holes in the rock was used. For the first 450 ft. the trestle consists of regular timber pile bents. Holes for the piles of each bent were prepared by dropping a series of four to five small bombs at the pile location from a derrick on the end of the trestle. After a penetration of 10 ft. had been blasted, the timber piles were driven to refusal in this shattered material.

The remainder of the trestle consists of bents of steel H-columns and steel bracing members at 30-ft. spacing required by the increasing depth and velocity of water. Since it was impossible to fabricate these bents in final position, a method had to be devsed to permit shore fabrication and direct placing on the rock. Preparation of the foundation for these bents was done by bombing the rock location for each leg to a depth of about 18 ft. Following this, an 18-in.-diameter steel pipe with closed pointed end was driven to refusal in this area of shattered rock. The assembled bent was then brought out by crane, and the two legs were placed in these driven pipes, after which the pipes were filled with tremie concrete. No difficulty was encountered in accurately locating the casings. This procedure proved very effective in handling the difficult problem of trestle construction in 30 to 45 ft. of swift water. Regardless of wind and tide conditions, these bents were set on the average of one every four shifts.

Organization

The Golden Gate Bridge is a publicly owned toll bridge being built by the Golden Gate Bridge & Highway District, James Reed, general manager. The engineering organization consists of Joseph B. Strauss, chief engineer, and a board of three consultants: O. H. Ammann, Leon Moisseiff and Charles Derleth, Jr. R. G. Cone is resident engineer. Contract for the two main piers is held by the Pacific Bridge Co., Portland and San Francisco, of which C. F. Swigert is president. Phillip Hart, vice-president, is directng operations, with A. E. Graham as superintendent and F. W. Crocker as chief engineer. The bombing method of subaqueous blasting was developed by Frank Camp. G. A. Strand, general manager of the Trojan Powder Co., aided in the solution of the explosive problems.

Ring-Connector Joints Used on Timber Bridge Trusses

Structures of 80-ft. span for logging railroad in Washington are outstanding application of European timber-connection device in this country—Tests confirm strength of joints—Design and construction outlined

By Walter J. Ryan and Wm. D. Smith
Engineer and Designer, Respectively, Weyerhaeuser Timber Co., Tacoma, Wash.

TIMBER tension members for 80-ft. Warren-type trusses, using ring-type connectors, are notable features of timber railroad bridges built by the Weyerhaeuser Timber Co. for its logging operations in southwestern Washington. For a Cooper's E-50 loading a design comparison indicated a saving of 6,000 ft.b.m. and 46,000 lb. of iron, principally in heavy angle blocks and vertical rods, over a combination Howe truss for the two structures. Truss members were fully detailed in a manner similar to shop detailing of steel structures and after framing were erected and shipped to the sites assembled.

In extending its logging operations supplying mills at Longview, Wash., it became necessary for the company to build three bridges over the Toutle River in Cowlitz County. One crossing required a 100-ft. span, and the other two were each 80 ft. Because of the clearance required for logging equipment, through trusses were impracticable, and a comparative study of steel deck plate girders and combination steel and timber deck Howe trusses showed the latter to be more economical.

After the 100-ft. span design was completed, the late John A. Pauw, structural engineer for the West Coast Lumbermen's Association, suggested that the use of an all-timber truss be considered, utilizing the Tuchscherer type of split-ring dowel for connecting the various members. Mr. Pauw had had wide experience in Europe in this class of construction and was sure that an economical design could be developed to suit the situation. Studies of his proposal indicated a considerable saving in first cost, and after a series of load

Fig. 1—Completed 80-ft., half-through, timber-truss railroad bridge with trusses covered for weather protection.

tests was made on various-sized rings, a decision was reached to build this type of truss for the 80-ft. spans.

Two types of structures were designed, a half-through pony truss and a deck truss with the ties bearing on the top chords in a manner similar to deck-plate girders. The first type was required at a site having limited vertical clearance above water surface. In general, the requirements and proportions of the two trusses were similar, including an 80-ft. span length c. to c. of bearings, a 10-ft. panel length, 12-ft.

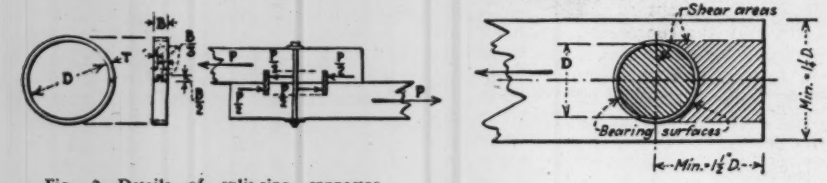


Fig. 2—Details of split-ring connector, showing method of use and distribution of shear and bearing stresses.

truss depth and 2½-in. camber. Load specifications included Cooper's E-50 live load, impact allowance to be taken care of by reduced unit stresses, and a dead load of 3½ lb. per ft.b.m. of timber.

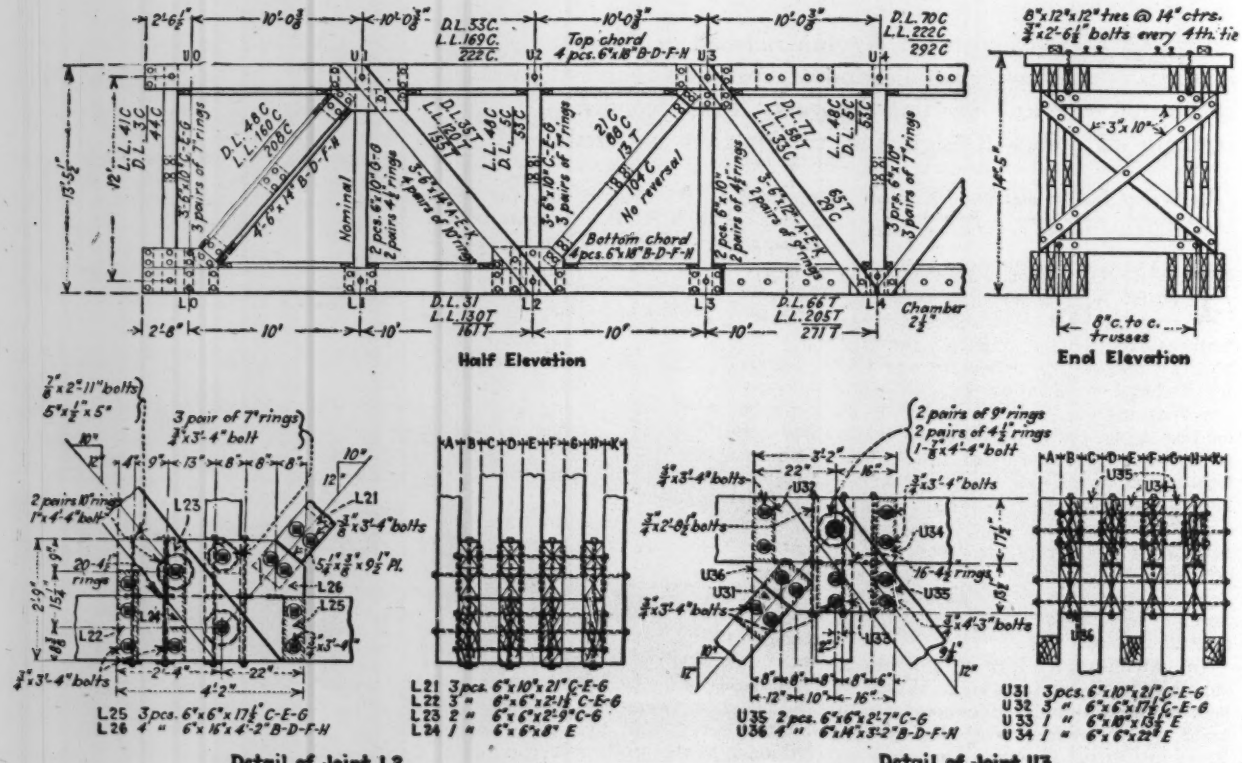
Ring Connectors—The Tuchscherer or Voss ring is a timber connector used extensively in Germany. It was described in the bulletin "Modern Connectors for Timber Construction" recently issued by the National Committee on Wood Utilization of the U.S. Department of Commerce and abstracted in *Engineering News-Record*, March 30, 1933, page 408. The connector (Fig. 2) is an annular ring of mild steel with rectangular cross-section and a tongue-and-groove break to allow expansion without changing alignment. Sizes range from 3 to 11 in. in diameter, with breadth and thickness varying accordingly. The rings fit into circular grooves cut into the adjacent faces of the wood members that they connect. Half of the ring is in each member, with a bolt through the center to pack the members and hold the ring snugly in place. The bolt has the additional function of resisting the overturning couple (Fig. 2) produced when the connection is under load.

When a load is placed on a connection it is transferred to the ring by bearing and produces a shear on the core formed by the circular ring slot. The ring, in turn, transfers the load to the opposing timber in a similar manner. Assuming a snug fit, it is evident that there are two bearing surfaces (Fig. 2) that divide the load equally between them.

There are two areas—the core and an area equal to the diameter and extending from the ring to the end of the stick—in which shear parallel to the grain is developed. The strength of the joint is thus determined both by the bearing strength of the two surfaces and the shearing strength of the two areas. Theoretically, these two should be equal, but in actual practice it is customary to make the rings of sufficient breadth to make the joint somewhat stronger in bearing than in shear.

The only data available on the allowable loads for the connectors were from European practice in which customary unit stresses in shear and bearing are used as a basis for computing the safe loads for each size of ring. To check these computed safe loads, a series of tests was run on 3-, 7- and 11-in.-diameter rings at the Canadian Forest Products Laboratory, Vancouver, B. C. The number of tests did not afford a sufficient range of conditions to permit making definite conclusions. The 3- and 7-in. rings, however, were satisfactory, showing a factor of safety of 4½ and 3½, respectively, for the computed values. On account of the capacity of the testing machine the 11-in. rings were tested with 4x12-in. timbers, which were relatively too thin for connectors of this size and so narrow that the rings protruded at the side. Failure

Fig. 3—Half-elevation of deck truss and details of typical joints; showing position of ring connectors. Note the use of wide and comparatively thin members to secure higher joint efficiency.



included splitting of the timbers. Although this was a poor test, the joint developed twice its computed safe load. As a result of the tests and the fact that German engineers use timber of considerably less strength than Douglas fir, the computed values were used in the design.

Unit stresses, in pounds per square inch, used in the design of the main members were:

1,200 for tension members.
1,400 for 22½ L/D compression members.
135 for shear parallel to grain in details.
90 for horizontal shear due to bending.
1,100 for bearing parallel to grain.
400 for bearing transverse to grain.

These stresses give loads conforming very closely with the safe loads recommended by German engineers.

Selection of Truss—Before selecting the type of truss to be used, numerous studies were made of both the Howe and Warren types. The Warren truss afforded simpler joint details and was selected for that reason. Pratt and Howe trusses have heavily stressed vertical members which must either take bearing directly on the chord members or be connected by ring dowels. In either case they produce compression in the chords perpendicular to the grain. The tests above mentioned indicate that in this type of joint the ratio of the width of member to the size of ring very materially affects the strength of the joint. Rings of sufficient size to develop the stresses in the verticals would necessitate very wide chord members, not less than twice the diameter of the ring.

In a Warren-type truss the verticals carry only a floor-beam reaction, and the more heavily stressed web members are diagonals that intersect the chords at about a 45-deg. angle. Tests on such 45-deg. joints indicate that the safe load is about 80 per cent. of the safe load when the rings cause bearing perpendicular to the grain on the joint members. A double-intersection Warren-type truss, eliminating all vertical web members, would be even better, and at the present time such a truss with a 100-ft. span is being designed. In this design the lower unit stresses are being used for the larger-size rings, as recommended by the Forest Products Laboratory from the results of their tests of the Locher ring, a cast-iron connector of similar characteristics to the Tuchscherer ring.

The first step in design was to choose the number and size of rings for the various connections. These sizes fix the dimensions of members, as it is necessary to have a width of face at least as great as the diameter of the ring, and the thickness of the timber is the smallest commercial size that will furnish a cross-section with the required strength. The result is a thin wide section. Tests show that the greatest joint strength is not developed if the ring is equal or greater in diameter than the width of the face into which it is set. Consequently, a standard face width of 5/4-

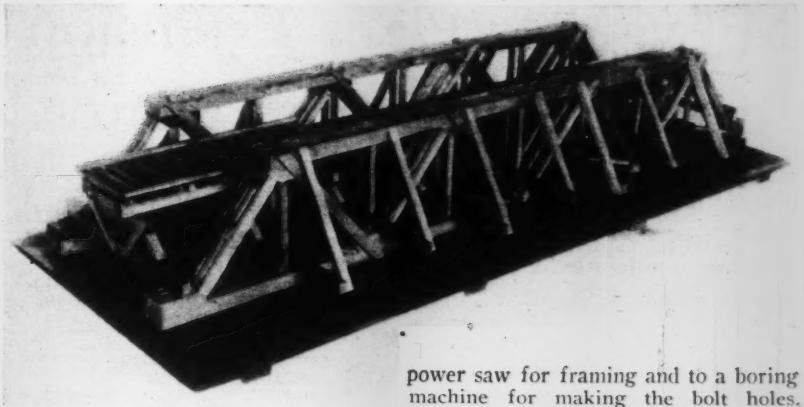


Fig. 4—To assist in framing and erecting, the contractor built this 1:12 scale model of the first bridge. It was complete in every detail, and pin connections in one truss permitted taking it apart to study joint assembly and location of rings.

ring diameter was adopted. Also an end-shear length of 1½-ring diameter was adopted to provide shear area at the end of the member.

The trusses were detailed in a manner similar to shop detailing of steel structures. All members were ring-connected except the compression diagonals, which are located in the plane of the chord leaves and bear on wood angle blocks. Small rings are provided between the chord members and the shoes to take the horizontal component of the diagonals. Diagonal tension members are interlaced between chord leaves, but to interlace the compression members would have resulted in either eccentric joints or an excessive over-all width of truss and awkward details.

Particular care was taken to provide quick drainage at joints and to avoid moisture-collecting pockets. Wide-spaced leaves in all members afford excellent ventilation, and with proper housing these spans should have a life equivalent to that of the covered wooden bridges that have served until they were retired on account of increased loadings. Under these conditions it was considered unnecessary to treat the timber.

The contractor elected to make a complete 1:12 scale model (Fig. 4) of the first bridge to provide a guide for the framing and assembling crews. Members were correct in every detail with the position of each ring groove marked. On one truss of the model, steel pins were used in place of bolts so that members could be removed for a study of detail joint framing.

The trusses were framed and assembled at a special plant erected near the sawmill. The timber was Douglas fir of structural grade. It was allowed to season for about two months after cutting and was then surfaced and taken to the framing yard as required. The timbers were laid out on a platform, and all bolt holes were carefully located. After the piece was marked it was placed on a set of rolls and run to a power saw for framing and to a boring machine for making the bolt holes. Then a second machine cut the ring grooves, the bolt holes serving as the centering for the accurate location of the ring. The cutting tools were adjusted to give $\frac{1}{32}$-in. clearance for the ring in the groove and a core diameter sufficiently large to expand the ring around the core, leaving the split open about one-half the length of the tongue.

The trusses for both bridges were assembled flat on a platform. As each piece was laid down, the required rings were painted with thick red lead and placed in the grooves. Faces of timber covered in the joint were painted with creosote, and the next member was put in place, fitting over the rings. The bolts were inserted after the joints were completely assembled.

The trusses for the half-through bridge were loaded on flat cars by two locomotive cranes and were unloaded at the bridge site onto pile and rock crib piers. The falsework had been decked for standard-gage track, and the locomotive cranes placed the trusses, removed the temporary deck and set the permanent deck into place. The trusses were housed with boards and battens, and the deck was covered with galvanized iron (Fig. 1).

In framing the deck, allowance was made to reduce the camber to about half the amount in the truss. The truss was checked after one year in service, and the camber was found to be uniform. Under a 250-ton load of locomotive and tender the deflection in the truss was half of the original camber. There had been some shrinkage of the timber, which was taken up by tightening the nuts, but there was no sign of play or deformation in any joint.

Erection of the deck-truss structure is awaiting completion of the piers. The trusses are stored at the mill.

The patent rights for the Tuchscherer ring connectors in the United States are held by the Timber Engineering Co., Washington, D. C., and the design of the 100-ft. trusses is being done under permit from this company. The authors were responsible for the carrying out of these bridge projects. The framing and erection contract was carried out by the Hart Construction Co., Tacoma, Wash., of which J. P. Hart is president.

Milwaukee Plans Extension to Activated-Sludge Plant

Experience of past seven years dictates important changes in new works, including two-arm sludge removers to operate in twin tanks, provision for less sludge return and substitution of circulatory for ridge-and-furrow method of applying air to aeration tanks

IN THE proposed extension of the activated-sludge plant for the Milwaukee Sewerage Commission a radical departure from any previous sedimentation-tank design will be made. The tanks are to be rectangular and equipped with two-arm sludge removers positioned and supported laterally through the use of a single overhead truss with structural-steel outriggers. Other new features in the extensions, which contemplate the continued use of the activated-sludge process, are the decision to make provision in the tanks and channels for a return of a maximum of 35 per cent of sludge; the use of $n = 0.030$ in Kutter's formula, rather than 0.020, for the coefficient of friction factor, this involving additional channel and overflow capacities; substitution of a circulatory method for the ridge-and-furrow system of applying air to the aerator tanks used in the existing units; the decision to use cast-iron pipe for air mains, and the conclusion to continue processing the sludge into fertilizer, as this method has thus far proved advantageous from a sludge-disposal standpoint.

Need for the extension arises from the fact that 25 m.g.d. (million gallons daily) of raw sewage is now being discharged directly into the rivers and into Lake Michigan, and by 1935, when the extensions are assumed to be completed, 39 m.g.d., or the sewage from 248,000 persons on the basis of 157 gal. per capita, will be untreated. The extensions are planned for 70 m.g.d., a capacity expected to last until 1945, when 155 m.g.d. will be produced (the existing plant handles 85 m.g.d.); but the proposed feed and return-sludge channels for the extensions have been designed for an ultimate of 115 m.g.d., making a total sewage-plant capacity of 200 m.g.d., which is the same as that of the contributing system of intercepting, main sewers and river siphons, coarse screen plant, grit chambers, fine screen plant, connecting channels, main bypass and outfall conduit. The maximum capacity is 300 m.g.d.

The site for the extensions is just east of the existing plant on land reclaimed from the lake. The preparation of the site is complete, and piles have been driven to support twelve aeration tanks and six sedimentation tanks and appurtenant channels. The matter of proceeding with the major contracts depends on how soon funds, now involved in litigation, may be made available.

Sludge-removal tanks

The proposed double tank for sludge removal (Fig. 2) is the outcome of several years' experience in the present plant. Experiments looking toward increasing efficiencies and economies in sedimentation have been carried on, first on laboratory scale and then in the full size. Preliminary experiments (*ENR*, July 10, 1930, p. 63) have been continued and additional tanks have been equipped with sludge removers consisting of horizontal revolving pipe headers to which are attached multiple sludge suction nozzles carrying the sludge outlets to the concentrated sludge over the entire tank bottom rather than moving it by plows to a single discharge point.

The first sludge remover of this type was installed in one of the 98-ft. tanks (No. 12) in 1928. In 1930 all tanks were ordered by the commission to be so equipped, but after the changes had been made on three more tanks (6, 7 and 15) it was considered advisable, for operating reasons, to defer the installation of the remaining units until the present proposed extensions are completed, when it will be more convenient to take the existing tanks out of service. These four tanks have been in continuous service to date, and several sets of tests have been made, the most comprehensive being conducted in December, 1931, in collaboration with engineers of the Sanitary District of Chicago. These tests indicated that the hydraulic type of remover could produce a reduction in sludge volume between 15 and 25 per cent over the scraper type and that the volume of effluent produced, because of the lesser water content of the sludge drawn, was increased between 5 and 9 per cent. There was an additional 8 per cent of solids on a dry basis in the discharged sludge when operating at an average settling rate of 1,530 gal. per sq.ft.

In addition to these economies, there are also those inherent in the design of the rectangular tanks, which are expected to produce more nearly uniform velocities than tanks of octagonal or circular shape. The basic attempt was to procure the best tank proportions possible, separate from and independent of the matter of removal of sludge. Finally, there are the savings in first cost over a single remover tank, due to the elimination of two tank walls and two complete trusses that would have to span the entire tank.

In so far as the functioning of the two-arm mechanism in the new rectangular tank is concerned, the nozzles are to be equipped with integral deflector blades so that in one complete revolution the entire tank bottom will be covered. An outstanding feature of the mechanism, in fact the one that led to its initial conception and design, is that it provides for complete removal of all sludge as it is deposited.

In asking for proposals it is the intention to consider three different types, Dorr, Hardinge and Tow-Bro, the last being the commercial development of

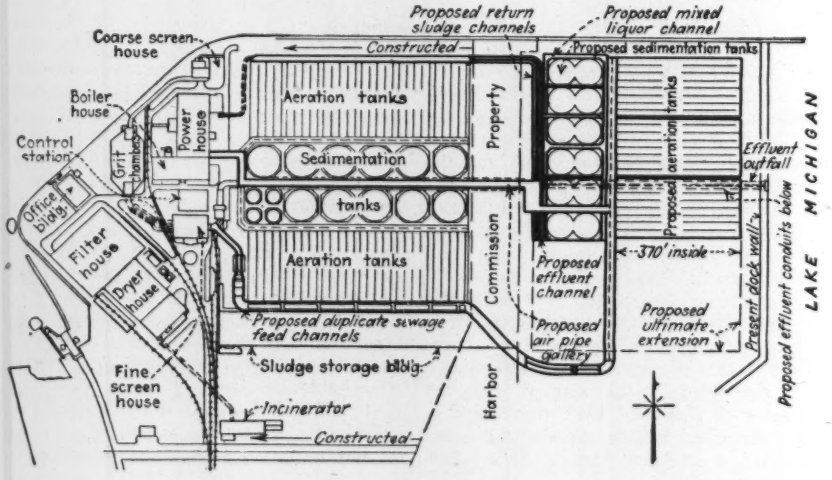


Fig. 1—Proposed extensions of Milwaukee sewage-treatment works on made land to east of existing plant. New construction, including feed and sludge channels, is shown in heavy lines.

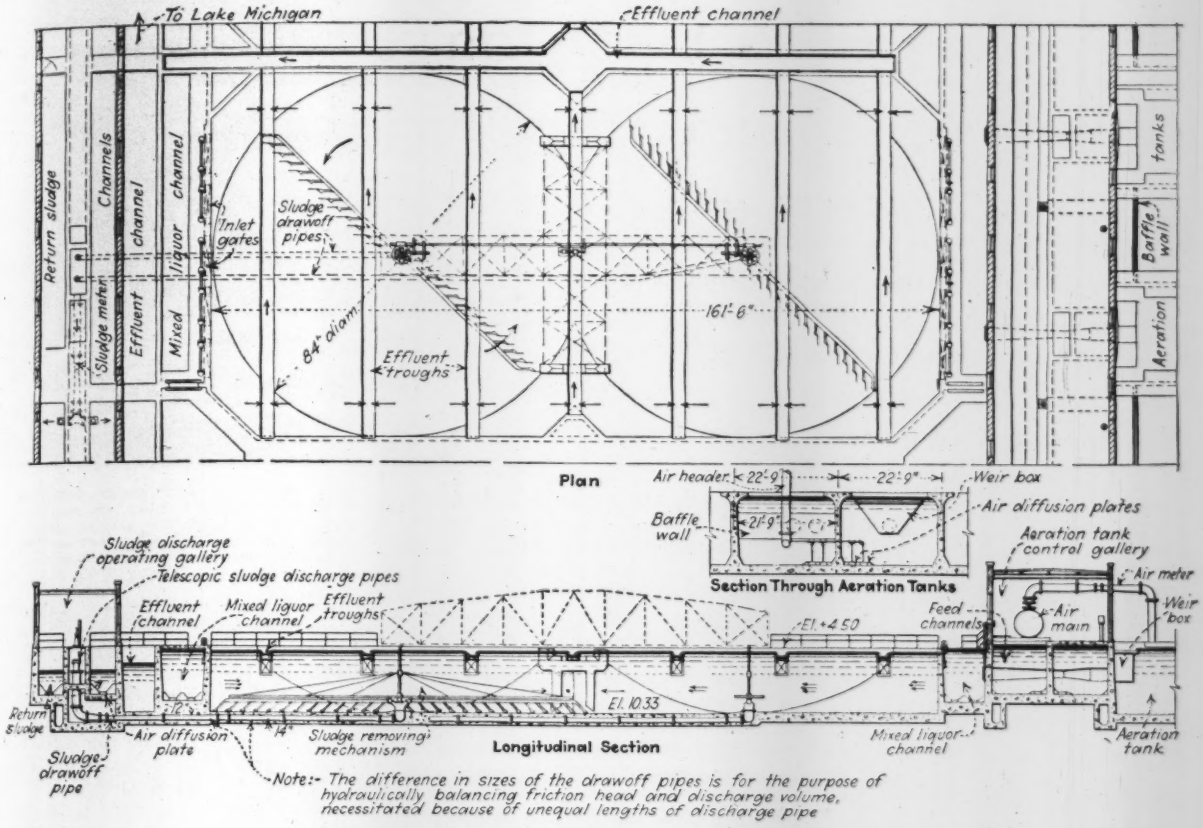


Fig. 2—Twin rectangular sedimentation tanks are to be equipped with two-arm sludge removers supported from a single truss carried on the center wall.

the suction type worked out at the Milwaukee plant. The final selection will be based on all pertinent factors involved, including initial cost, adaptability and efficiency as well as the economics involved in the entire process of treatment through the return to the raw sewage of sludge of concentrations obtainable through the use of the different types.

In the original Milwaukee plant the basis of design of the sedimentation tanks was 1,600 gal. per sq.ft. sewage basis. This could not be successfully attained, and the average solid content of the sludge was appreciably less than the 1½ to 2 per cent expected. The new rectangular tank with the hydraulic removers is based on a maximum rate of 1,600 gal. mixed liquor per square foot daily, and at least 1½ per cent average solids content in the abstracted sludge when the mixed liquor contains a solid content ranging from 3,000 to 4,000 p.p.m. The effluent for most of the time is expected to be little, if any, in excess of 10 p.p.m.

Sludge returns

The maximum amount of sludge to be returned in the new extension (35 per cent) has been selected largely upon the basis of the operation of the existing plant during the last five months of 1931 and the first three months of 1932. Prior to these periods sludge was returned at excessively high rates and relatively low solids content, due appreciation not having been previously given to the over-all economic value directly attributable to and obtainable through the return of a lesser volumetric quantity containing a higher percentage of solids. During the first seven months of 1931, 42.43 per cent of sludge was returned. Solids were 0.85 per cent. The maximum rate was 55 per cent and 0.78 per cent, respectively. These figures are representative of previous operation. From August, 1931, to April, 1932, the sludge return was 23.74 per cent, with a corresponding solids content of 1.63 per cent. The average occasional maximum rate was 37 per cent, with a solids content of 1.5 per cent. In consequence, 25 per cent for average and 35 per cent for maximum sludge return and 1.5 per cent solids were adopted in the new design.

Friction coefficient

At the time the existing plant was designed one of the elements of uncertainty existing was that involving the matter of selecting an adequate cofficient of friction for use in connection with sludge, mixed liquor and feed channels equipped with air-diffuser plates. The coefficient selected for use ($n = 0.020$ in., Kutter's formula), while considered extremely conservative at the time, proved in subsequent operation to be inadequate. Results of flow-resistance measurements and observations extending over a period of several weeks led to the belief that the flow rates, originally assigned upon the basis of $n = 0.020$, were excessive, within the limits of hydraulic head available, by at least 33⅓ per cent, and that in the subsequent design of similar channels the use of $n = 0.030$ would appear reasonably justified.

Because of these hydraulic limitations the existing mixing channels following the fine screens must be supplemented with additional length of overflow weir to permit 100 per cent utilization of the existing main bypass and effluent conduit during times of bypassing following fine screening.

It is also because of hydraulic limitation that the existing feed channels would not be adequate, if extended to serve an extension to the existing tanks, to supply sewage in sufficient quantity to warrant the expense of their construction. Hence extension of the existing duplicate feed channels was not considered feasible, and additional mixing channels, overflow and feed channels are planned. The feed channel crosses the south end of the present aeration tanks, and the sludge-return channels are located just outside the north end of the north battery of aeration tanks, as shown in Fig. 1.

Design of the new aeration tanks is based on results with existing units that are 236 ft. long, 44 ft. wide and 14.3 ft. deep, each of which will treat 3.5 m.g.d. and will give a detention period of 5.7 hours. Upon this basis each cubic foot treats sewage at the rate of 25.02 gal. per day, or 347 gal. per sq.ft. of horizontal liquid surface. This latter is equivalent to 15 m.g.d. per acre. Applying this data to the twelve proposed tanks, the dimensions come out 370 ft. long, 42 ft. wide and 14.6 ft. deep from the flow line over the weir crest to the top of the diffuser plates. The latter are 6½ in. above the tank bottom.

In the present tanks air is applied through a ridge-and-furrow system. In the new tanks a circulatory system will be used. Longitudinal rows of diffuser plates are placed along one side of the tank instead of at fixed intervals over the entire bottom, thus effecting a substantial initial saving of plates. Although there is a partial offset to this saving by virtue of the construction of top-flared walls instead of straight section walls, the combination is less expensive. Circulatory systems are used in Chicago, Indianapolis, New York City and Cleveland.

The objections to the use of the ridge-and-furrow system, which are calculated to be overcome through the use of a circulatory system, may be stated as twofold—namely, the greater initial and subsequent replacement expenditure necessitated for diffuser plates and precast concrete ridges or separator blocks, and the inclination of the diffuser-plate furrows to fill with inorganic and other precipitated sewage substance, thus decreasing the efficiency of air application. At such times as this condition has existed to any marked degree, it has been necessary to drain the tanks and remove the deposits. No such deposits are anticipated in the tanks in which the circulatory method of applying air has been installed.

Another advantage of a circulatory system is the added flexibility in the rate of air application. This is particularly advantageous in this case, where the capacity will be excessive during the earlier years of operation. With fewer plates (about one-half those required in the ridge-and-furrow system) relatively low rates of air application per unit of time and prolonged detention periods will permit the use of a greater number of tanks. For example, each of the proposed tanks, as designed, is to be equipped with a total of 1,316 diffuser plates arranged in double rows. On the basis of supplying air at the rate of 1 cu.ft. per plate per minute, which is the minimum allowable, approximately twelve hours of detention would be necessary to produce the degree of oxidation necessary to comply with the fixed standards. If approximately twice this number of diffuser plates are used, as would probably be the case if the ridge-and-furrow method were employed, and if air is supplied at the minimum allowable rate of 1 cu.ft. per plate per minute, the total amount of air supplied would necessarily be double that used in the former case, and the necessary detention period would be decreased more or less automatically as a result, in accordance with the economics involved in the application of compressed air.

As the sewage flows increase, the detention periods will be progressively decreased and the rates of air application will be progressively increased until the design basis adopted (which is considered the minimum allowable consistent with known requirements) has been established, after which time additional extensions will be required.

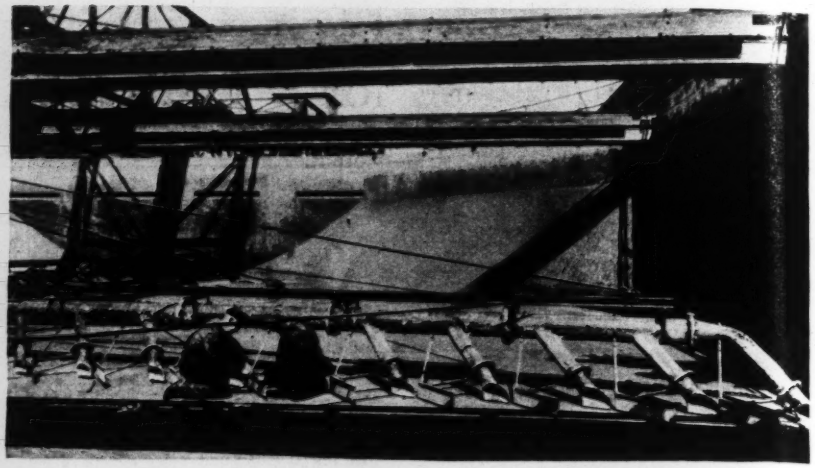


Fig. 3—The two-arm sludge removers planned for the new tanks are now installed in four of the existing tanks. Sludge is removed through flared suction pipes into which plows direct the sediment.

General design and arrangement

Except as previously noted herein, the general design of the proposed extensions, from a structural standpoint, is quite similar to that of the existing plant. The proposed plant structure as a whole is to be supported upon a wood-pile foundation, the piles to serve as anchorage against the hydrostatic uplift as well as to carry the superimposed loadings. Past experience has indicated that plain pile heads imbedded in the concrete floor slabs develop sufficient bond to provide against hydrostatic uplift, and therefore no mechanical bond is necessary. Reinforced-concrete walls of the cantilever type have been selected for use throughout, and flat reinforced-concrete slab design has been used for the tank and channel bottom.

Operating galleries adequately proportioned to house the main air-supply pipes, control valves, measuring and recording apparatus, etc., have been designed substantially in accord, from a structural as well as from an architectural standpoint, with the existing operating galleries.

The main supply or feed channels, as well as the return-sludge channels have been designed in duplicate because of the necessity for insuring uninterrupted operation when diffuser-plate removal and replacement or channel cleaning is necessary, the use of diffuser plates in the channels being unavoidable within the existing hydraulic limitations.

The main 12x13-ft. feed channels are equipped with electrically operated sluice gates located in a suitable housing structure at the beginning of the duplicate channels. Just ahead or upstream from these gates the return sludge will be introduced into the sewage through a pipe equipped with a control gate. This sludge pipe, which will be equipped with a venturi meter, is a prolongation of the existing line now serving the present plant, the total sludge to be supplied to the sewage being pumped to the two points of application by existing centrifugal sludge-pumping equipment.

Emergency overflow weirs, similar to those provided for the existing mixing channel, are located just ahead of the point of return-sludge application. The sewage overflow passes these weirs at such times as may be necessary and is to be carried through connecting underground conduits that terminate in the main plant effluent and bypass channels, which channels in turn and at all times will discharge their flow into Lake Michigan.

The proposed duplicate return sludge channels are 6 ft. in width and about 8 ft. in depth to the top of the dividing wall, and are located between the ends of the north battery of aeration tanks and the U.S. Government South Harbor Pier. All of the sludge to be discharged from the proposed sedimentation tanks will flow through these channels and through a short length of pressure conduit to the existing return-sludge pumping plant located in the northeast corner of the power plant.

From an economic standpoint the studies indicated that an entirely separate and independent air main is desirable. This 72-in. main is to be cross-connected in the power house to the existing blowers as well as to future blowers

and, as now contemplated, will be extended to the proposed plant through a second-story gallery to be constructed on top of the existing and centrally located sludge-operating gallery. Between the easterly end of this gallery and the proposed plant-operation gallery, the construction of a connecting gallery will be necessitated, the structure being sufficiently low to permit, if and when it might materialize, the possible construction ultimately of an overhead viaduct structure, in accordance with tentative existing plans of the Milwaukee Harbor Commission.

In determining the size of this air main, the basic rate of 1.5 cu.ft. of free air per gallon of sewage treated was used in conjunction with the "Thorkelson" friction formula of $P = \frac{LV^2}{25{,}000B}$ in which P = loss of pressure in ounces per sq.in.; L = length of pipe, in ft.; V = velocity of air, ft. per sec.; and B = diameter of pipe, in in.

The use of this formula has been reasonably justified in the operation of the existing plant, as friction losses found to exist exceed by very little those determined on a theoretical basis.

That the air mains will be of cast-iron pipe is a matter rather definitely established. The smaller-size piping, which in the existing tank is wrought-iron, will in all probability be cast-iron, because it is believed to be more resistant to corrosion than wrought-iron has proved to be under conditions present in the aeration tanks.

Sludge-disposal facilities

From recent studies the conclusion has been reached that the existing facilities for processing waste sludge into Milorganite appear to be adequate to serve until the year 1940, and probably will be utilized as they now exist to their fullest extent. If the question of sludge disposal by incineration subsequently appears susceptible to satisfactory economic solution, the sludge-disposal facilities of the future may result in a combination of Milorganite production and disposal by incineration.

The existing waste-sludge conditioning facilities for pre-treatment through the application of chemical re-agents prior to filtering, and those existing in the form of isolated aeration and sedimentation tanks, are adequate to serve until the 1940 period and longer. The new incinerator for grit and screening likewise is good until 1940.

The sewage-works extension of the Milwaukee Sewerage Commission is under the direct supervision of James L. Ferebee chief engineer, and T. Chalkley Hatton, consulting engineer. Darwin W. Townsend, principal assistant engineer, is in charge of design. He, with James Brower, superintendent, developed the hydraulic sludge remover, which has been patented and taken over by the Chain Belt Co.

Local Administrative Units for Rural Roads

Conclusions reached at conference of Institute of Public Administration of the Social Science Research Council

A ROUND-TABLE conference on desirable units of government for the administration of rural highways was recently arranged by the Social Science Research Council. In addition to several state highway engineers, there were in attendance representative county and township engineers, men connected with the financial and legislative branches of government and a number of professors of economics and government. Under the chairmanship of Dr. Luther Gulick, director of the Institute of Public Administration, the conference spent two days in the discussion of the problems of town, county, state and artificial districts as highway control units. The discussion showed substantial agreement on the following points:

1. The traditional American system of local highway administration, though already greatly revised in certain states, needs to be re-appraised throughout the country as a whole in the light of modern developments. The day of the small-town highway superintendent—elected, poorly paid and with no technical qualifications—is over.

2. The present-day requirements for a unit of local self-government to deal with highways are: (*a*) size and wealth to hire on a full-time basis a properly trained highway engineer and minimum staff; (*b*) size and wealth to own and use economically the minimum required highway machinery; (*c*) wealth to finance the current and capital costs of local highways with a minimum of state aid; (*d*) size, topography, population, resources, procedure and tradition, making possible and probable the efficient maintenance and intelligent planning of local highways in relation to needs, resources, through highways, and to the other community services such as schools, health, recreation, etc.; and (*e*) size, procedures, traditions of self-government, and means of communication which make it easy for the citizen to know about and have an influence in the determination of highway policies.

From the general conclusions the following corollaries were drawn with general (but not unanimous) agreement:

With rare exceptions the township is an inadequate unit of local-highway administration in all of the states. In many of the states the counties are inappropriate on account of inadequacy in one or more of the essentials above stated. It was the feeling of the conference, however, that it is not possible to generalize with respect to the present units of local government in the United States because of the extreme variation of such uniform terms as township, town and county. The conference was not at all agreed that the solution of the problem of local highways was to be found through the establishment of the state as the sole highway unit. However, it was felt that extreme centralization would be justified under suitable local conditions.

Where the highway unit is less than the entire state, the local officials should be obliged to use the most efficient methods in design of roads, use of machinery and purchasing supplies. To this end the state should make available its testing laboratories, its service of inspection at the source, its purchasing department and a pool of the more expensive machinery.

Where existing governmental subdivisions (counties and townships) meet the above requirements, their effectiveness can equal that of specifically set-up highway units by adequate cooperation with the state authorities. In some cases this is now being accomplished with eminent success and without compulsion, due to the ability and tact of the state engineers. Where necessary, such cooperation should be compelled.

While there is divergence of opinion regarding the seriousness of objections to specifically set-up agencies, all agree that it is desirable (if practicable) to have all local self-governing services confined within the same limits. This is not important if the local highway unit is purely an administrative subdivision of the state and if there is no local taxation for any class of roads.

Since one-third of the road mileage, made up of first- and second-class roads, carries about 90 per cent of the traffic, this one-third should be financed by the state through gasoline and automobile taxes. These roads should be administered by the state. The remaining two-thirds mileage is exclusively in third-class roads, those whose use is almost entirely by persons residing on them. There are three proposals for the financing and administration of these third-class roads, namely: (1) by the state; (2) by the smallest unit of government which can employ a well-qualified engineer, the expense being met by local taxation with or without state aid; (3) by a combination of the state and the smallest unit, the state standing all the expense of keeping the roads in minimum usable condition, while the users of each particular road have the privilege of a more highly improved road at their own expense.

NEW PLANS FOR THE MISSISSIPPI

Developing the Atchafalaya for Greater Floodflow

Sixth of a Series of Eight Articles

Creating a self-maintaining channel in the Atchafalaya River by shortening, slope equalization and removal of constrictions by cutoffs and agitation dredging

SINCE Mississippi flood control became the object of engineering attention, the problem of what to do with the Atchafalaya River has been a key question in every plan for regulation. The history is interesting and has a direct bearing on present improvements of the Atchafalaya, as referred to in the first article of this series (*ENR*, June 22, p. 795).

Work prior to 1880

At the time of the earliest records and until 1831 the Atchafalaya was a direct all-stage outlet of the Mississippi River. The situation as it existed is indicated by the sketch plan of Fig. 1; the Red River emptied into the Mississippi near the bight of Turnbull Bend, and a little farther around the bend the Atchafalaya flowed out of the Mississippi. This was, for present consideration, the original condition of nature.

In 1831 man took a hand. At that time the outlet reach of the Red River was shoaling badly, and a bar interfering with navigation had formed in the Mississippi below the mouth of the Red River. The navigation interests became proponents of a plan to cut off Turnbull Bend, and in 1831 the cutoff was made, as shown by Fig. 1. It was called Shreve's Cutoff for its chief sponsor, Captain Shreve, of Mississippi steamboat fame. The length of the loop cutoff was 15 miles.

The effect of Shreve's Cutoff, aside from shortening the channel, was to shift the zone of shoaling farther downstream. In an attempt to improve this condition, a second cutoff, named Raccourci Cutoff, was made at the next sharp bend downstream by the state of Louisiana. This operation reduced the channel length 19 miles (Fig. 2), but failed to improve the channel above.

Shreve's Cutoff brought down upon the river engineers a new hydraulic problem, that of controlling the outflow from the Red and the inflow to the Atchafalaya. Although a single problem in certain essential features, the Red and the Atchafalaya presented quite different conditions, which required separate as well as coordinated consideration.

The peregrinations of the new outlet of the Red River require first mention. With the completion of the cutoff there were three means of outlet for the Red, the two arms of the old loop and the Atchafalaya. To reach the Mississippi, the river first took the northern arm of the loop, then known as Upper Old River, while the lower arm, Lower Old River, deteriorated to a condition of virtual closure. But the channel of Upper Old River also shoaled badly, and navigation at low water often was

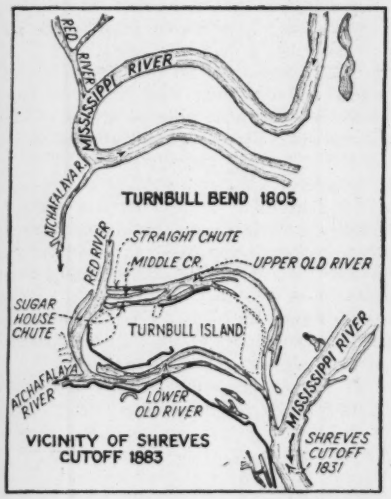


Fig. 1—Turnbull Bend and the Red and Atchafalaya rivers before and after the completion of Shreve's Cutoff in 1831.

impracticable. Finally the Red abandoned Upper Old River, and in 1872 reopened a channel through Lower Old River. This channel has since constituted the connection between the Red, the Atchafalaya and the Mississippi and is known as Old River. Old River now flows toward the Mississippi or toward the Atchafalaya, according to the relative stages of the two streams.

In 1831 the Atchafalaya had a clear channel for about 20 miles from its head, and from there it was choked with an almost continuous floating raft of compacted drift from the Red and Mississippi rivers. This raft ceased to increase after Shreve's Cutoff was made, and its removal was begun in 1840 and completed in 1861.

Beginning with Ellet's report and continuing until 1844 through those of Humphreys and Abbot and the reports of subsequent commissions and boards of engineers, including the Mississippi River Commission, consideration was given to the place and function of the Atchafalaya in flood control. Up to 1879 the reports generally advocated the continuation of the Atchafalaya outlet. In 1880, however, Major W. H. H. Benyaurd, reporting independently of the Mississippi River Commission (which had been created only a year before), came forward with proposals to separate the Red and Atchafalaya from the Mississippi. A review commission rejected these proposals on the ground that they would increase the danger of floods.

Work under the M.R.C.

With the organization of the Mississippi River Commission, a change of attitude toward the Atchafalaya became evident; closure of the outlet gained cautious favor. The M.R.C. in its 1880 report had come out definitely for the doctrine of levees only as a method of river control and regulation. In its 1881 report it presented the conclusions of a special committee that: *(a)* the Atchafalaya was capable of taking the drainage of the Red and Black river systems; and *(b)* restoration of the main river levees above the Red and checking or closing the outlet of the Mississippi into the Atchafalaya would result in material reduction in the extent of flooding in the lower Tensas and upper Atchafalaya basins.

Further studies continued until 1884, most of them directed toward determining the possible effects of separating the Atchafalaya from the Mississippi. Generally the advocates of this action offered three main reasons: *(a)* the separation would prevent the feared possibility that the Mississippi might turn through the Atchafalaya and take a new shorter course to the Gulf; *(b)* the outlet to the Atchafalaya tended to cause deterioration of the main river channel below; and *(c)* the exclusion of Mississippi waters from the Atchafalaya would reduce floods in the Tensas and Atchafalaya basins.

In 1884 the M.R.C. took definite action. The plan as worked out through a number of years is indicated by Fig. 3. The flow conditions following Shreve's Cutoff, it will be remembered, were such that the Red, when it changed its Mississippi outlet in 1872 to Lower Old River, flowed directly into the Atchafalaya, the channel to the Mississippi became a kind of equalizing channel whose direction of flow shifted

according to the relative stages of the Mississippi and the Atchafalaya.

The first step in the M.R.C. plan of 1884 was to prevent any possible diversion of the Mississippi to the Atchafalaya by restricting the access channel. Specifically, the plan was to build six submerged sills in the upper Atchafalaya. By 1889 two of these sills had been completed. The second step was to divert the Red River directly into the Mississippi by building a dam (Fig. 3) that would again turn the flow through Upper Old River. A low dam was to be built at first, and then, as the outlet channel developed, it was to be raised to cut off all but floodflows. This dam was completed in 1890 to about one-third the planned height, and various dredging operations were conducted to open the new channel. But the Red refused diversion, and so the dam was removed in 1901, conditions remaining as in Fig. 3. The levee system shown had been developed in the meantime.

Since 1926, maintenance of the Simmesport sills had been abandoned, and they are deteriorating. The effect of all the operations described has not been either to control the enlargement of the Atchafalaya or to alter the channel of the Mississippi. Instead, the channel of the Atchafalaya has constantly increased as its levee system has been extended. Through the leveed portion the bankfull cross-section is now from two to three times that of 1881 when levee construction began. The flood capacity between levees is now calculated to be about 500,000 sec.-ft.

The new project

Following the flood of 1927, which set at naught all existing works as safeguards from overflow, Congress dealt a completely new hand in Mississippi flood legislation. A new and comprehensive flood-control plan was adopted (*ENR*, June 22, 1933, p. 795). In it the basin of the Atchafalaya was made one of four floodways to carry off flood crests from the main river. Specifically, with existing levees raised, the Atchafalaya was to be developed to carry 500,000 sec.-ft. Floodway levees were then to be built parallel to the river levees and connected across the head of the basin by fuse-plug levees that would be overtopped and breached when the capacity of the Atchafalaya channel was exceeded. This surplus floodflow would be confined by the floodway levees, and the total flow in the floodway and channel was to reach a total of 1,500,000 sec.-ft. in the contemplated superflood on which the flood-control plan is based.

This plan in its essentials is continued in the new planning by the river engineers, but the function of the main channel of the Atchafalaya has been greatly magnified. As shown by Fig. 4, the channel, to the end of the present levees at about mile 54, is a reasonably efficient hydraulic conduit. Below this point it becomes crooked, and at about

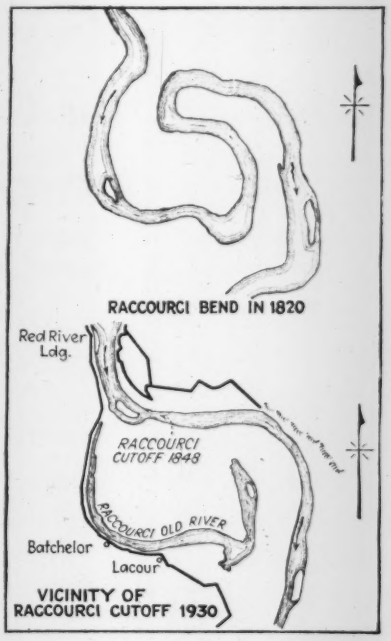


Fig. 2—Raccourci Cutoff, made by Louisiana in 1838 to remedy bar formation caused by Shreve's Cutoff.

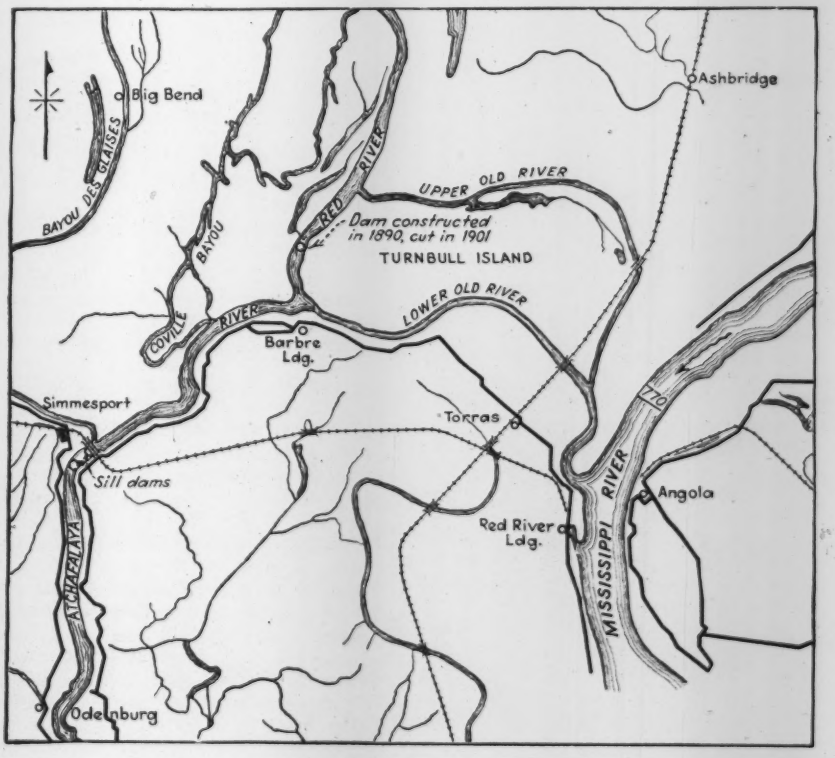
mile 67 it loses itself in a maze of tortuous waterways and tidal lakes. A glance at these conditions will make the hydraulic problem evident.

Hydraulically, the Atchafalaya consists of four parts: the well-defined upper channel between levees, as indicated by Fig. 3; the bayou portion, where the channel becomes crooked and the flow splits up and becomes almost unidentifiable, as shown by Fig. 4; the lake portion, where the dispersed flow finds its way into Grand Lake, which, with its variously named arms, extends down to Morgan City; and the lower river portion from Morgan City to the gulf, as shown by Fig. 5.

As previously stated, the upper Atchafalaya is, with the levees raised about 2 ft., a reasonably good hydraulic conduit for 500,000 sec.-ft. between levees. From Grand Lake to the Gulf, with the present restriction at Morgan City, the channel capacity is 700,000 sec.-ft. Grand Lake will carry all the water that can find egress at Morgan City. Above Grand Lake, in the bayou section, there is restriction due to various causes. First is the crooked channel. Then Grand River, which strikes almost squarely across the Atchafalaya and is a sediment-bearing stream, has built up the characteristic ridge of alluvial rivers. This ridge is about 10 ft. high. Furthermore, the mere diversion of flow, as indicated by Fig. 4, has the effect of channel constriction, particularly as these channels are constantly changing due to sedimentation that shifts from one to another. Finally, there is a fundamental reason why this diversion exists, and the Atchafalaya never has formed a defined channel from Grand River to Grand Lake (Fig. 4).

In past ages, perhaps when, as the geologists indicate, the present Atcha-

Fig. 3—Junction of the Red, Atchafalaya and Mississippi and controlling levee system of recent years before operations on the present project.



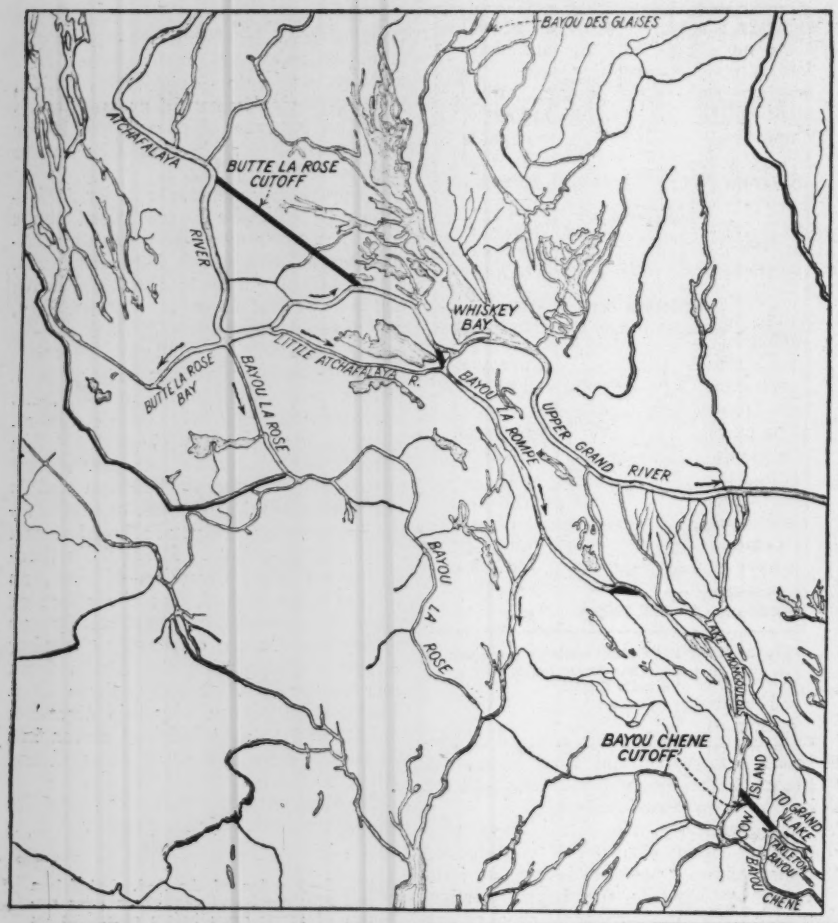


Fig. 4—Section of Atchafalaya now being straightened by cutoff and point-flattening.

falaya was the path of the Red River to the gulf, lenses of hard clay were built up across the valley. So far, the river operations have definitely disclosed four of these clay deposits in a river length of about 15 miles. The clay deposits are 8 to 10 ft. thick and, as indicated in previous articles (*ENR*, July 13, p. 41), they erode so slowly that they have for generations effectually prevented the river from cutting a direct channel through them.

With the zone of constriction as described from Grand Lake to Upper Grand River and this zone constantly being built up by accretion of sediment, two alternatives were presented for the flood improvement of the Atchafalaya. One was the extension of the levees both in length and in height, and the other was to increase the carrying capacity of the channel. It was decided to make the experiment of trying to enlarge the channel. The method being followed is described in a succeeding section.

It is essential to note in this connection that at high-water stages the Red River backwater area is in reality a large lake fed by the Mississippi, Red and Black rivers and having the Mississippi and Atchafalaya rivers as outlets. This lake begins to fill up as soon as the inflow exceeds the outflow, which at present occurs at a relatively low stage. An increase in the capacity of the Atchafalaya will prevent this lake from filling until higher stages are reached and so will make an increased storage available to help reduce flood peaks. Provision of an adequate channel for the Atchafalaya through its present delta section will likewise keep drained, until arrival of high stages, a large storage area in this region that now becomes flooded at relatively low stages.

The distinctive feature of the plan is that the river itself, aided by artificial agitation of the bed, is to perform the work of channel development by its own current power. The theory in brief is that it takes two or three times the current power or energy to detach material from the bed that it does to keep it moving when detached. The construction procedure then is to dredge the bottom with suction dredges and discharge the stream of water and earth overside into the channel, where the current will seize it and by suspension and bottom drag carry it downstream. As a practical example of the theories of current tractive power and bed-load movement development by the model tests described in a preceding article, this operation is of extraordinary interest.

The present work on the channel has

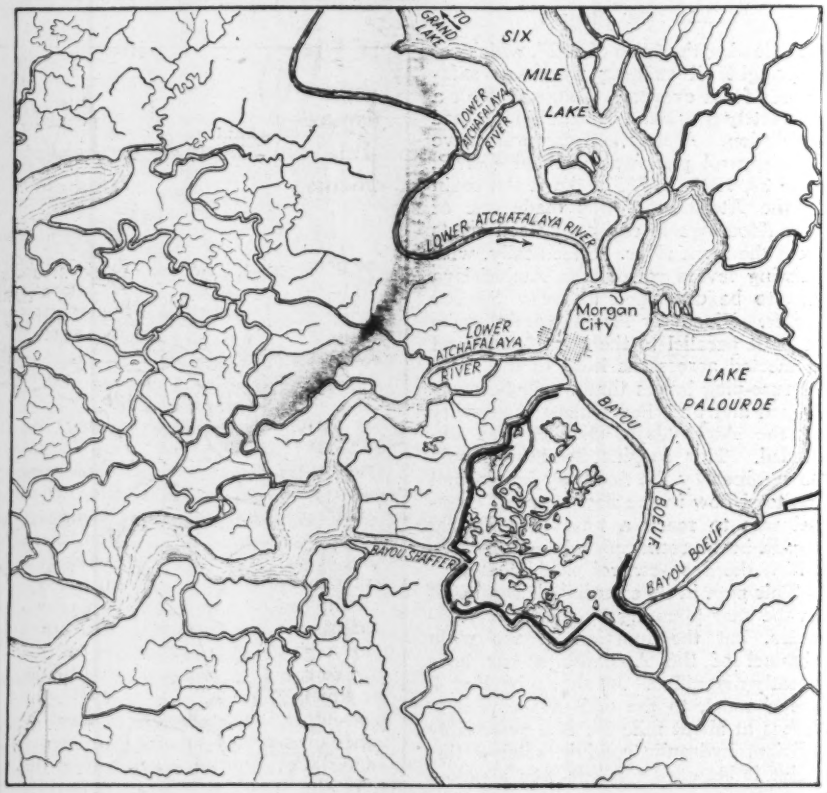


Fig. 5—Lower portion of Grand Lake and the Lower Atchafalaya River from Grand Lake past Morgan City and to the gulf.

proceeded to the point of constructing the Butte La Rose, Cow Island and Bayou Chene cutoffs and removing a number of the point constrictions. (Fig. 4.)

Construction of the cutoffs has been accomplished by cutterhead hydraulic dredges disposing the spoil by pipe line along the banks of the cuts. This same type of dredge has been used in cutting off a number of points and in cutting through a number of the more resistent constrictions in channel cross-section along the proposed channel route shown in Fig. 4.

The development of the main channel is being aided by agitation dredging. Two types of agitation dredges are employed. One type is similar to the seagoing hopper dredge, and the other is a pump barge.

The dredges of the first type that are being employed were converted from U. S. Shipping Board lake-type freighters. Additional boilers, pumps and engines were added to this type of boat, and two 30-in. side drags were installed capable of working to depths up to 50 ft. The dredge operates while underway along the channel to be improved, pumping the discharge overboard from the side of the dredge just above the water surface. The material loosened from the bottom is thereby dispersed through the flowing current and carried downstream whenever sufficient energy is available.

The pump barges are designed to be used either singly or in pairs. Each barge has a single 30-in. drag with sufficient boiler and pumping capacity for its operation. These drags are capable of working to depths of 50 ft. The barges may be pushed by a towboat or can pull themselves forward by powerfiul hauling winches. When operating with a towboat, the discharge is overboard alongside above the water surface while the unit is underway. When operated by hauling winches, the discharge may be handled in the same manner or, by attaching 500 ft. of floating discharge line to each barge, may be disposed at a distance from the dredged cut.

The pump-barge units may be worked from depths of 6 to 50 ft. The lake-type freighters require approximately 17-ft. draft, which limits their operations to depths from 20 to 50 ft.

Actual operations on the channel project have required the use of some floating clamshell equipment for special cases of enlargement at the heads of cuts and in closing minor outlets, but the major part of the work is being carried forward by the cutter-type hydraulic pipe-line dredge and the two types of agitation dredges described above. As the work progresses, it is hoped that the major part of the operations may be carried on by the agitation dredges.

Handling Extra-Work Orders in Building Construction

Verbal agreements source of most disputes—Use simple printed forms for all extra work orders—Bill all extra work when done and make concessions or adjustments at time of settlement

By Carl V. Hobaugh
General Contractor, Butler, Pa.

THE EXPRESSION "extra work" may mean various things. For the purpose of this article it will be defined as the transaction involved and the expense incurred by making changes or additions to a contract already entered upon, particularly a contract taken for a lump sum, or one for which the contractor has guaranteed the final cost.

In attempting to analyze some of the influences that develop the problem of extra work it appears to the writer that they divide into three factors: a business problem, a psychological one and methods of bookkeeping. Although the dividing lines are many times indistinct and most of the conditions can be met with good business practices, yet the contractor is often forced to apply his knowledge of human nature to save both himself and the situation.

The general source of complication is, perhaps, the contractor's own carelessness, and by that I refer particularly to his willingness to make verbal agreements.

Do business in writing

The major contract will no doubt be written up in a form that will give the contractor the proper measure of protection for his rights. Since the owner is usually desirous of a written agreement for this primary transaction, there should be no trouble about making a contract that will be fair to both parties.

For the contractor to come to a previous mutual agreement with the other parties regarding any changes to this major contract is, however, a valuable habit worth acquiring. To put all such agreements to make changes in writing, whether or not they involve extra work or material or additional expense on the part of the contractor, is an important and necessary procedure that no contractor should neglect.

It would seem quite reasonable that the contractor would be interested in having all of his secondary agreements in a definite written form for reference in the event of a breach of contract by the other party. But this is not always the case, and many contractors are contented to change and revise their contracts by verbal understanding, which in most instances are so vague that, despite the sincerity of all the parties concerned, it is doubtful if they can remember the true intent of the bargain some months afterwards. Furthermore, a satisfied customer is equally important as business security, and his experiences have been such as to convince the writer that a definite and logical business procedure for handling any extra work done is a great aid at the final settlement in helping to establish a relationship that may mean future business.

A great many architects are very careful about placing all their orders and instructions in writing, and the contractor working for them is not so apt to become involved in those endless discussions that lead nowhere. But in dealing with other architects or in dealing directly with the owner the contractor is continually called upon to see himself that this is done.

While a letter properly written to cover all the necessary points may suffice for these secondary agreements and changes to the major contract, means to write such a letter are not always available, and for this reason the writer likes a printed form for this work. This should be small enough for the men to carry about and keep with them at all times, should be made as simple as possible and should be filled in at the time of the bargain, even on the job if necessary, by the person in charge of the work. This, in itself, is a great aid in doing away with verbal agreements and procrastination; the architect or owner, being forced to place his instructions in writing and to sign them, is more definite in stating what is to be done, and how it is to be paid for, especially if he knows that no work will proceed until these conditions have been met.

The stating of secondary transactions in writing and in simple form, the writer believes, is a business safeguard for which all contractors should strive. But, being an ideal, it has a tantalizing way of staying just beyond the reach of a complete accomplishment. While such a safeguard may never be made to function perfectly, the difference between a sensible application and theoretical perfection can be made so small by intelligent handling and sincere effort on the part of the contractor that it will serve for all necessary protection.

Causes of trouble

To attempt a discussion of the psychology of human relations, in so far as they affect extra work, is an ambi-

tious undertaking for any contractor. The writer, in order not to get beyond his depth, will confine his remarks to the few examples which experience has presented to him.

Differences may arise from extra work items due to the individual characteristics of the parties concerned. One of the outstanding and important axioms of the business world, translated into the phraseology of contracting, is this: "Each contract entered upon has all the potentiality needed for a legal fracas." A slight misunderstanding is a spark which the wind of an arrogant disposition can soon fan to a consuming flame, and perhaps to the ash-heap of financial loss or a blighted friendship. Let us hope that such arrogance does not belong to the contractor, for to continue to have satisfied customers he must at times help guide their actions and decisions. Often, in addition to protecting his own interest, he must assist in safeguarding them from their inexperience. A controversy pushed through to a legal decision is most often an expensive gesture, for victory has a discouraging way of placing her rewards in the pockets of the attorneys.

It is a fact much to be regretted that the owner does not always understand his plan and specification before he awards his contract; also that some architects do not know enough about the cost of construction. But the contractor who endeavors to overload the cost of these extra items, whatever his reason may be, is inexcusable. Extra work may also be made more costly and difficult by the contractor who is not willing to give a proper consideration to the professional ability of the architect, or to cooperate with him. Architects, too, who question the sincerity of attitude or purpose of the contractor without due cause when he has suggested a change or addition, are not serving the best interests of the owner. These potent causes of friction the writer will pass over by simply naming them.

When the structure begins to take shape and the outlining features become recognizable, the owner may find that it does not quite follow the picture he has in mind, or perhaps the architect discovers he has made some errors which need to be corrected. These parties usually accept their responsibility and are willing to make a fair adjustment with the contractor for any changing he may do for them, although the disappointment and resentment that is sometimes aroused over the extra expense or delay caused by such alterations may try the patience of the contractor, especially if he is unjustly accused of having foreseen the contributing fault.

Furthermore, a great many changes, if they are at all serious or have been delayed too long, have a way of turning out to be rather costly or of not working out so well architecturally, and it

ORDER FOR EXTRA WORK

To CARL V. HOBAUGH
Butler, Pa.

Order No.
Date.....
Job No.....

Job .....
.....
.....

Please furnish all necessary material and labor required to perform the following work as noted below, and charge to our account:

.....
.....
.....
.....

1. The above work to be paid for at actual cost of labor and material plus..... per cent.
2. All the above work to be completed for the sum of..... Dollars
3. .....
.....
.....

Signed ..... Architect
Owner
Per .....

Order for extra work to be filled in and signed when order is given. All contractor's men who are authorized to receive extra-work orders carry these blank forms.

is well for the contractor to protect himself by seeing that these possibilities have had due consideration, especially if he is willing to proceed on a verbal agreement. It is most often a questionable practice to be too sympathetic with an owner who desires to make changes with every passing whim. If the contractor is not careful, he is apt to be left stranded by that clever device known technically as "passing the buck."

Occasionally, too, the architect or owner will seriously tilt for a concession, and the contractor, in his enthusiasm to please, forgets his own interest and agrees to do certain small jobs without a proper compensation, or he may be gently led into assuming such an attitude by the eloquent appeal of the other party. This is a situation for which no rules can be laid down, but the contractor will soon find that such financial drains will strangle his business, and such practices will eventually lead to more involved complications, with perhaps serious results. To avoid establishing a precedent, which may become embarrassing, it is best to

JOB NO. ..... Date .....

CARL V. HOBAUGH
General Contractor
BUTLER, PA.

This is the amount of labor and material required for extra work order No..... for the week ending.....
This work is not completed.
You are requested to file this as a check against our statement which will be sent to you later.

Name F S M T W T Hours Rate Amt.
.....
.....
.....
.....

Work done by Labor
Material changed to Material
Their order No.
Foreman Supervision
Checked by TOTAL

Form for billing each order for extra work. Back of sheet carries statement and cost of materials used. Each extra work order is billed as a separate transaction.

develop a tactful resistance as support against those customers and architects who like to solicit extra favors on the strength of their patronage. The experiences of the writer have led him to believe that if the contractor wishes to make some concession to these parties in appreciation of their support, it should be made at the final settlement for the reason just stated, and never during the life of the job, for favors granted then slip too easily from mind.

Bookkeeping practice

In undertaking to discuss the bookkeeping factors the writer will briefly outline his own method, and the reader can place upon it whatever valuation he may choose. He has found that many times, for some cause or other, costs will get jumbled together in such a way that the exact cost of any extra work cannot be separated from the job cost either for a record of them or to provide the proper support for an itemized statement to the owner. For this reason the writer likes to keep the labor and material cost for these items of extra work free from the contract part of his work, and he believes the easiest way of doing this is to treat them as individual jobs, complete within themselves. This record for such work should show the labor, material and other costs completely as if it were the only transaction between the parties. In all fairness, too, it would seem that the owner is entitled to a copy of this cost record, especially if the extra work has been given on a cost-plus or fixed-fee basis.

The little form shown, with the time sheet on the front and the material record on the back, is used by the writer to meet these requirements. It was originally designed to be used for small odd jobs, and the form was taken to the job and used as the original time and material sheet. Carbon copies were also made, and one of them was sent to the owner at the end of each week or when the job was completed. They proved so useful and were so well liked that we changed the wording enough for them to be used in the same manner for extra work items on the larger jobs. This has proved to the writer to be a simple and direct method for these transactions and also to be a valuable aid to the owner in helping him keep within his budget.

These two forms, together with a written order for the work, provide the contractor, owner or architect with a complete record of this transaction of extra work. And they go a long way to smooth out the difficulties of the final settlement.

The extra work form is a very common one and no doubt is much like the form many other contractors are using. It is given here principally to illustrate some of the remarks the writer has made regarding such a form, and will explain itself.

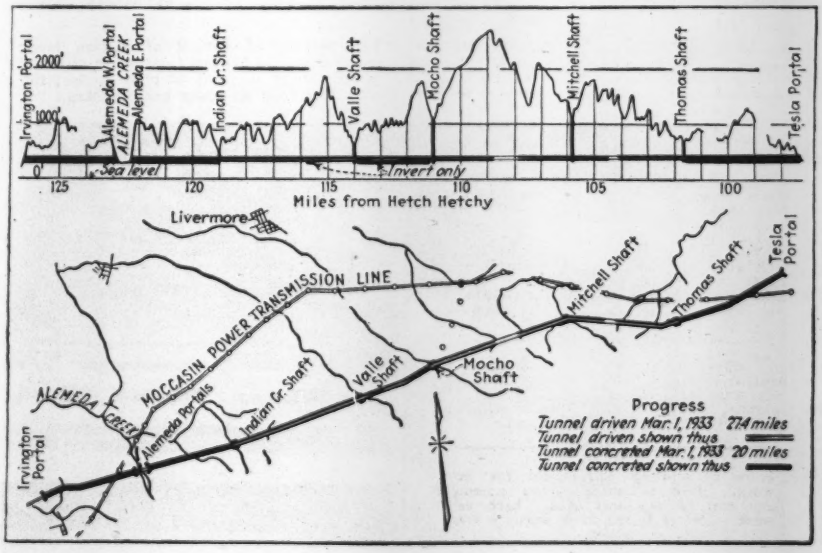
Lining the Coast Range Tunnel for Hetch Hetchy Water

Circular concrete lining for 10.5-ft. water-supply tunnel is designed to meet wide pressure variations in heavy ground—Two-step program provides for paving the invert and pneumatic placing of side walls and arch in a three-shift operation

INTEREST in the lining of the Coast Range tunnel for the water supply of San Francisco lies in the design for squeezing ground; in the development of a three-shift placing method; in operation from only three points with maximum underground haul of 7 miles; and in the batching plants. Including 120,000 cu.yd. of sublining, which replaced timbering in squeezing ground, concrete volume is about 500,000 cu.yd. Concreting has been timed to be completed with the completion of the driving this fall and the opening of the aqueduct, which is scheduled for the spring of 1934.

The plan and profile of the Coast Range tunnel are shown by Fig. 1. Briefly, the work has involved the driving of 28.6 miles of tunnel from five shafts and four portals, Alameda Creek cutting through the tunnel line about 3½ miles from the west end to form two of the portals. Driving has been completed except for a few hundred feet between Thomas and Mitchell shafts and about a mile between Mitchell and Mocho. Work on the Mitchell-Mocho section was delayed at the start by the necessity for sinking shafts 812 and 823 ft. deep and the heavy ground encountered on practically the entire 5.3 miles of this division. The method of attacking the work and the driving operations have been described in *Engineering News-Record*, Jan. 15, 1931, p. 96, and June 1, 1933, p. 701.

Fig. 1—Plan and profile of Coast Range tunnel, showing progress of driving and lining on March 1.



Design of lining

The formation through which the tunnel has been driven consists principally of sedimentary rocks varying from hard schist through sandstone and shale to badly disintegrated water-bearing material. Much of the ground, in addition to being extremely heavy, has the tendency to squeeze and move for months before reaching equilibrium. This condition has necessitated heavy timbering for much of the distance and the use of a pneumatically placed concrete sublining for several miles where conditions were extreme. The entire tunnel will be lined to 10½ ft. for inside diameter, and the design problem has consisted of providing a lining to resist the varying pressures encountered in different parts of the tunnel.

The basic assumption accepted the timbering as the indicator of the pressures. If timbering of a given size and spacing had successfully held a section of ground without apparent distress for a considerable time, it was considered that a concrete lining designed for a working stress equal to the ultimate strength of this timbering would be adequate. In addition to the factor of safety available in the concrete above its assumed working stress, the timber obviously was not stressed up to its ultimate strength. In sections where a sublining had been used, more careful measurements were possible; here strain-gage determinations of deflections and movements were used as a basis for the design of the concrete lining.

The lining provides a 6-in. minimum thickness inside all timbering. Timbers are set 9 in. outside the finished line to provide a margin of 3 in. in case of minor movement. The weight and condition of the ground, in practically all timbered sections, does not allow the removal of the timbering prior to lining operations, and concrete is therefore placed around the timbering. This necessitated strength calculations based primarily on the heavy concrete rings between the sets, as the 6-in. thickness of lining across the face of the timbers provides only a small amount of the strength required. These requirements and the pressures encountered resulted in placing a concrete lining varying from the required 6-in. minimum thickness in front of the 8x8-in. timber sets to a maximum of 36 in. at the heaviest section. The lining is shown in Fig. 2.

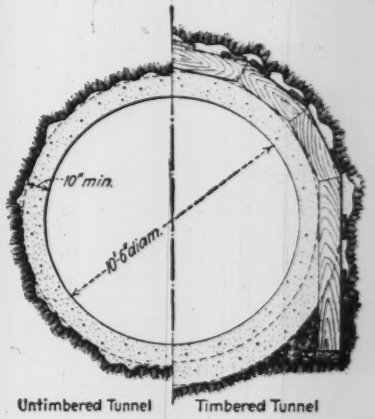


Fig. 2—Characteristics of lining, showing relation of concrete thickness to size of timbering.

Although the principal variable factor in the lining design was the thickness of the concrete, to a limited degree the lining design could be changed by varying the strength of the material, and where necessary the strength of the concrete was varied from 3,000 to 4,000 lb.

Aggregate and batching plant

Aggregate has been prepared and stockpiled at three locations along the tunnel line. The design and operation of the portable plant (of 100-ton-per-hour capacity and used to prepare about

Fig. 3—Dry 1-yd. batches are dropped through a well and loaded into 2-yd. cars spotted by air hoist. The operator controls the loading and regulates the surface-batching plant output by telephone and signal.

1,000,000 tons of aggregate at these locations) was described in *Engineering News-Record*, Dec. 1, 1932, p. 654. Three sizes of aggregate were produced: sand, ¼ to ¾ in., and ¾ to 1½ in. Over-run material crushed by the plant constituted a small fraction of the finished product. From the stockpiles the aggregate is trucked to the three batching plants, as required. Large deposits of excellent sand and gravel were found near each proposed batching plant and also tracts of level land for stocking all prepared aggregate in advance of starting lining operations.

After intensive study as to the best method of attack, balancing features of plant cost, accessibility to sections of the tunnel as completed, underground procedure and natural deposits of raw aggregate, it was decided to establish three surface-batching plants. Near the western end of the tunnel one plant was established at Alameda Creek, where two portals provided access. Skipping the first shaft to the east (Fig. 1), which was only 3 miles from the Alameda Creek portal, the next plant was placed at Valle shaft, about 8½ miles farther east. Again, skipping the two deep shafts where driving operations were to be under way the longest, the third batching plant was established at Thomas shaft, about 4½ miles from the eastern portal.

By this arrangement the plant at the Alameda Creek portals batched material for the sections both east and west, providing a 6-mile maximum haul east to connect with the operations handled from the plant at the Valle shaft. Likewise, on the eastern end of the tunnel the plant at Thomas shaft was used to complete the section to Tesla portal and will handle the 4½-mile division west toward the Mitchell shaft. Finally, after the last section, Mitchell to Mocho, is holed through the plants at Valle and Thomas shafts will batch the aggregate for this closing link. This schedule eliminates the use of two deep shafts for handling aggregate, but it requires underground hauling a maximum distance of about 7 miles.

The batching plants are generally similar in design. Timber ramps are provided for dumping the three classes of aggregate in stockpiles that have under-tunnels provided with gates and a conveyor belt. Material from these stockpiles is withdrawn, weighed and moved by conveyor belt toward the cement weigher. Cement is delivered by trucks, lifted by bucket elevator to a steel silo and fed to an automatic scale. The crew at each batching plant, as the result of the careful arrangement of design and equipment, consists of only three men: a foreman, who superintends operations and handles the cement unloading, and two operators in the tunnel handling the weighing of the ½-yd. batches of aggregate and cement.

At the Alameda Creek portals these batches were loaded directly into cars and hauled into the tunnel. At the shaft plants other provision had to be made. Lowering or dropping the aggregate down the shaft was impossible because of interference with other operations. Therefore, at each of the two shafts a 16-in. well was driven from the surface to intersect the main tunnel line about 200 ft. from the cross-cut at the shafts. A 10-in. heavy steel welded pipe was concreted into each of these holes. The upper end of the pipe is provided with a hopper located at the end of the conveyor belt from under the batching plant, and the lower end is provided with a small hopper and air-operated sliding gate for regulating discharge into the cars (Fig. 3).

Fig. 4—At the mixing plant a short conveyor belt under an incline track handles the batches from the cars directly into the 1-yd. mixer. Cars are pulled from the passing track up onto the incline by an air hoist operated by man on left.

The cars used to transport the dry aggregate underground are of 2-cu.yd. capacity; a partition divides the body into two compartments with separate discharge doors. These cars are handled in six-car trains by 5-ton storage-battery locomotive from the well to the point of lining. To eliminate the need for a locomotive waiting to spot the cars for filling and to give better control, a small air-operated hoist is provided. An operator seated opposite the well hopper controls the train of cars and hopper gate and is in communication with the batching plant on the surface by means of telephone and electric signals. Each batch is handled as a separate unit, comes down the pipe by itself, is emptied into the compartment of a car, and the gate is closed before the next batch is dropped. The loading of a six-car train with twelve 1-yd. batches normally requires about 10 min. These trains are removed as required by the locomotive bringing up the empties.

Concreting the invert

In the timbered sections driving operations leave the tunnel floor at the elevation of the bottom of the set. Clean-up prior to invert placing requires moving the 24-in. gage track, excavating the bottom to its final circular section and replacing the track. The possibiilty of making this clean-up for long distances ahead of invert placing

Fig. 5—Original method of placing invert concrete was by buggies from mixer (left) on plank runway to point of pour (right), followed by screeding and finishing.

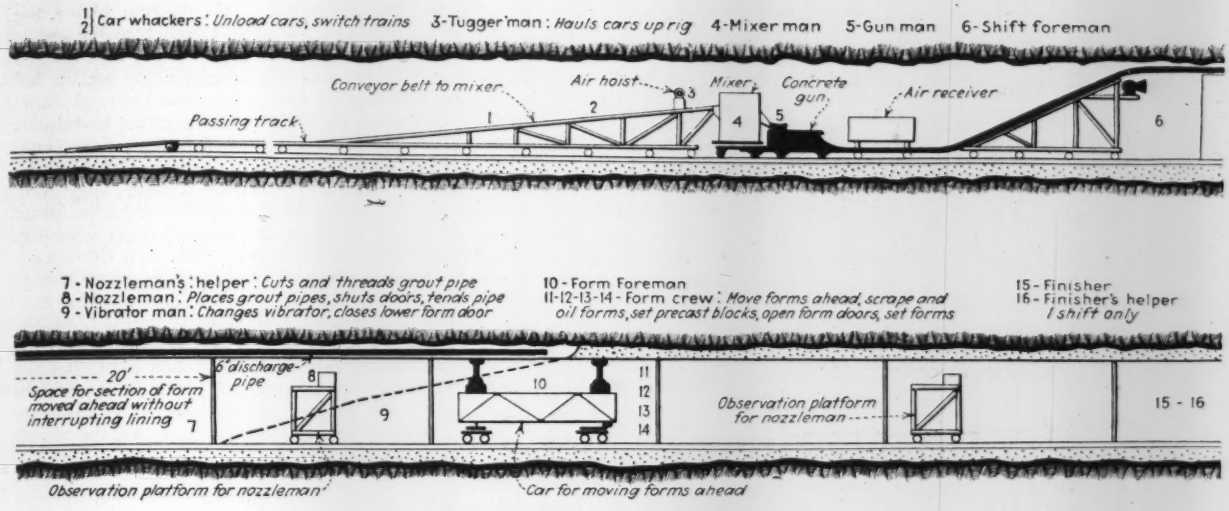

1|2 Car whackers: Unload cars, switch trains
3-Tugger man: Hauls cars up rig
4-Mixer man
5-Gun man
6-Shift foreman
Conveyor belt to mixer
Air hoist
Mixer
Concrete gun
Air receiver
Passing track
7 - Nozzleman's helper: Cuts and threads grout pipe
8 - Nozzleman: Places grout pipes, shuts doors, tends pipe
9 - Vibrator man: Changes vibrator, closes lower form door
10 - Form Foreman
11-12-13-14 - Form crew: Move forms ahead, scrape and oil forms, set precast blocks, open form doors, set forms
15 - Finisher
16 - Finisher's helper
1 shift only
20'
Space for section of form moved ahead without interrupting lining
6" discharge pipe
Observation platform for nozzleman
15 - 16
Observation platform for nozzleman
Car for moving forms ahead

Fig. 6—Diagram of lining plant for sides and arch, permitting continuous operation. Arrangement of equipment and disposition of crew is shown.

is limited because of the tendency for the timbering to move in when the bottom is disturbed. In the sublined sections the ballast is removed, the concrete cleaned and washed, and the tracks are placed on timber stringers supporting the ties. This clean-up operation also involves handling the water so that the invert can be placed in the dry. In some cases a small flow is collected in sumps and lifted into the 8-in. drain pipe in the tunnel. In other cases, tile drains along the bottom covered with crushed rock are placed to convey the water to sumps, from where it can be pumped into the 8-in. line.

The invert concreting rig consists of a long elevated passing track accommodating a loaded and an empty train of aggregate cars, a short incline track over a section of a conveyor belt to transfer the batches from the cars into the mixer, a 1-yd. electrically operated mixer and conveyor belt for distributing the concrete into the invert section. This entire outfit moves on the 24-in.-gage tunnel track and is pulled back in 60-ft. moves by an air hoist and a six-part line. The elevated passing track is blocked up at each move. Form setting for the invert forms are edge forms providing a simple offset keyway for the longitudinal joints.

The loaded aggregate train, disconnected from its locomotive, is pulled up onto the elevated passing track by air hoist, and the empty train is lowered down to the locomotive. In two-car units the loaded cars are pulled forward by air hoist onto a single-line track and up over a short length of conveyor belt (Fig. 4). Single batches are discharged onto the conveyor belt and dumped directly into the mixer. The empty cars are let down onto the other passing track, and the operation is repeated until the train is unloaded. In early operations the mixed concrete was handled by buggies on a temporary timber runway (Fig. 5) and distributed along the 60-ft. invert section being poured. A recent development provides a long conveyor belt to handle the concrete from the mixer to the point of placement. As the concreting rig is moved back, the original rails and tracks are removed and hung on the wall until the invert concrete sets.

Water for concrete mixing is obtained in the tunnel whenever analysis shows that it is suitable. This has been the case in several extended sections, the water being collected in sumps and pumped to the mixer. Otherwise, mixing water is obtained from the pipe line in the tunnel. Invert concrete is mixed comparatively dry, about 1- to 1½-in. slump. A 3,000-lb. concrete is ordinarily used for the invert, and a typical mix is 1:2.4:4.2.

Invert concreting is carried on two shifts per day, leaving the third for cleaning up, moving and form-setting. The progress averages about 300 ft., which represents the placing of some 150 cu.yd. of concrete (½ cu.yd. per lin.ft.). The record, using buggy placement, was 423 ft. in two shifts and 6,800 ft. in a single month. Following the placing of the invert, the track is relaid on timber stringers and ties in readiness for the lining of the sides and the arch.

Concreting sides and roof

Concrete for the sides and arch of the circular section is placed by a concrete gun shooting behind steel forms, with the same general type of concreting rig used on the invert. Operations are arranged for continuous placing, and the work is carried forward during three shifts.

The handling of aggregate trains is the same as in invert construction with the exception that the even support provided by the invert permits the use of timber skids under the edge of the double passing track so that it can be moved without reblocking. The mixer discharges directly into a 1-yd. concrete gun, which utilizes the compressed-air supply available in the tunnel. This is normally 100 lb. pressure at the compressor and about 90 lb. at the gun. Care is exercised to avoid using too much air for other purposes, as rapid placing requires a good supply.

The collapsible steel forms built up in 5-ft. lengths are handled in 20-ft. units. The lower ends that overlap 1½ in. on the invert are braced against the track, which is in turn provided with a spreader to take the load off the rail spikes. On the sides the forms are set to line by concrete spacer blocks resting against the timbers or the sublining, and temporary blocking on the arch provides the only hold-down necessary. Doors are provided every 10 ft. on either side and at the top. The operator in charge of the discharge pipe from the concrete gun directs it by watching through one of the arch holes. While concreting is in progress the forms are vibrated by small air vibrators. The concreting outfit moves as one unit from the end of the discharge pipe to the incline on the forward end of the double passing track, a distance of about 300 ft. Moving is done by air hoist and a six-part line as required by the progress of concreting. The general arrangement of this equipment is shown by Fig. 6.

The concrete gun discharges into a 6-in. pipe, 70 ft. long, which is carried up to the roof of the tunnel on a timber jumbo and above the steel forms. The length of the discharge line permits of erecting a 20-ft. section of form at the forward end without interfering with the gun operation. Forms are brought forward on a car equipped with special steel frame carrying two jacks to lower the form from its original position and set it in place. A period of twelve hours is allowed between the placing of the last concrete in a section of forms and the removal of that section of forms. Sufficient forms are provided so that the

operation can be carried forward continuously. The entire crew, including the motorman bringing batched aggregate and the form-moving crew, totals 20 men.

Concrete for the side wall and arch lining is mixed with a 4-in. slump. The 3,000-lb. concrete is proportioned 1:1.96:3.5 for a typical mix, and the 4,000-lb. concrete has a typical proportion of 1:1.36:2.4. Progress for three shifts averages about 200 lin.ft., and the concrete volume for sides and arch, although varying considerably with the lining thickness designed for the particular section, averages about 2½ cu.yd. per foot. The maximum record to date for three shifts is 274 ft., and more than 6,000 ft. has been placed in one month.

Grouting follows completion of the lining and is carried on through pipes nailed to the timbering, at 20-ft. intervals, in the arch section prior to the placing of the arch concrete. These holes are subsequently drilled into the rock to insure the grout passing into the line of contact. In sections where the lining is placed without the removal of the timbering, the grout averages about 0.35 to 0.5 cu.yd. per foot to fill the spaces in the timbering and the cribwork that are impossible to fill completely with the lining concrete. In the sections that have been receiving the sublining directly against the excavation the amount of grout required is very small, but the progress is carried forward to fill any possible seam between the concrete and the sublining and also behind the sublining.

In addition to this arch grouting, holes are drilled at intervals through the invert, and these holes are tested with grout, although in most cases they will not take any. The grout used averages about 0.45 cu.yd. per linear foot of tunnel. The grouting pressure is 60 lb. per square inch.

Directing organization

The Hetch Hetchy water-supply project for San Francisco is being carried out by the public utility commission, Edward G. Cahill, general manager. M. M. O'Shaughnessy is consulting engineer to the commission. L. T. McAfee is the chief engineer and manager in charge of the project, and L. W. Stocker is chief designing engineer. The Coast Range tunnel work is being carried on under the direct charge of C. R. Rankin, construction engineer. W. F. Webb is superintendent of lining operations.

Improved Transition Adds to Flume Capacity

Change in hydraulic characteristics of transition, using timber lining, increases flow limit from 360 to 400 sec.-ft. in Agua Fria River flume of Roosevelt Irrigation District

By J. A. Fraps
Engineer, State Engineer's Office, Phoenix, Ariz.

IMPROVEMENT of the transition intake section of the Agua Fria River crossing flume at a cost of $500 has affected an 11 per cent increase in the flow that can be put through this structure of the Roosevelt Irrigation District near Phoenix, Ariz. The original intake section, during capacity operation, did not provide sufficient gain in velocity from the canal section, with the result that the water surface was too high, striking cross-members of the flume. This resulted in a skimming action restricting the flow to a net capacity of 360 sec.-ft. The new transition, as indicated by careful studies and initial operation at partial capacity, shows that the improvement in hydraulic characteristics at the entrance will raise the capacity of the flume to 400 sec.-ft.

This improvement resulted directly from studies made in the office of the state engineer at the request of the state certification board of Arizona in reference to the feasibility of approving a $600,000 bond issue of the Roosevelt Irrigation District that was to be used in lining canals of the system. A study of the economics of lining the canals involved the carrying capacity of the Agua Fria River flume. The lining operations would result in increasing the capacity of the system above the flume to 390 sec.-ft., whereas the maximum flow that could be put through the flume was restricted to 360 sec.-ft. because of entrance conditions. A thorough analysis of the entrance hydraulics indicated that the increased flow could be accommodated in the flume if the entrance transition were improved. Upon completion of the study the board turned over the suggested plan for improvement to the officials of the irrigation district, and a temporary timber transition was built and is now in operation with satisfactory results. As the result of increase in the capacity of the river crossing, the board approved the bond issue, and the canal lining will be undertaken to decrease losses and increase capacity as soon as the bonds can be sold.

Original transition

The typical section of the canal upstream from the flume is trapezoidal, with a bottom width of 8.6 ft., side slopes of 1:1 and a 7.2-ft. water depth. The canal is lined with Gunite, which was placed against a loose fill and has settled and warped badly, increasing the coefficient of roughness. A slope of 0.0002 exists in this section of the canal. Gradual widening of the canal takes place from 50 to 100 ft. above the flume, and at a point 50 ft. above the flume the canal has a bottom width of 10 ft. and side slopes of 1.54:1.

A Lennon-type flume, with semicircular section 13.37 ft. in diameter, forms the Agua Fria River crossing. This flume is 6,000 ft. long and has a slope of 0.0006. Because of a small amount of sand carried in the canal it has been necessary to protect the flume with asphalt paint. This tends to increase the coefficient of roughness, as the heat of early summer melts the asphalt coating, causing it to run down the sides of the flume and to accumulate in small rough patches. Also, small nodules ap-

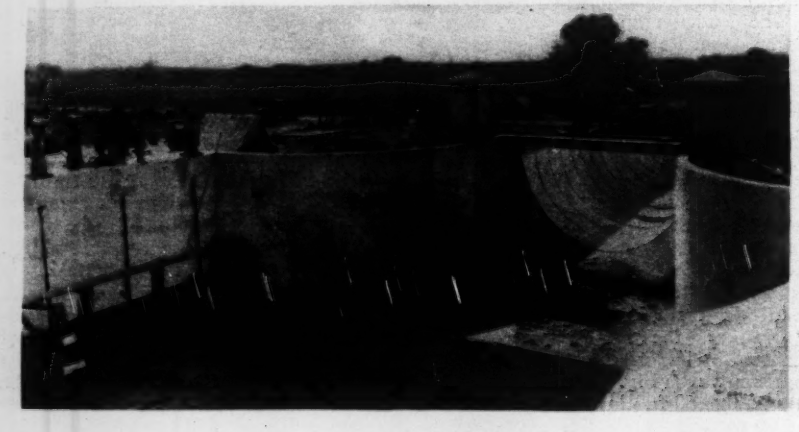


Fig. 1—Original flume entrance, showing sand trap with abrupt change in bottom section, and short transition that did not produce sufficient velocity with corresponding drop in surface to put capacity flow into the flume.

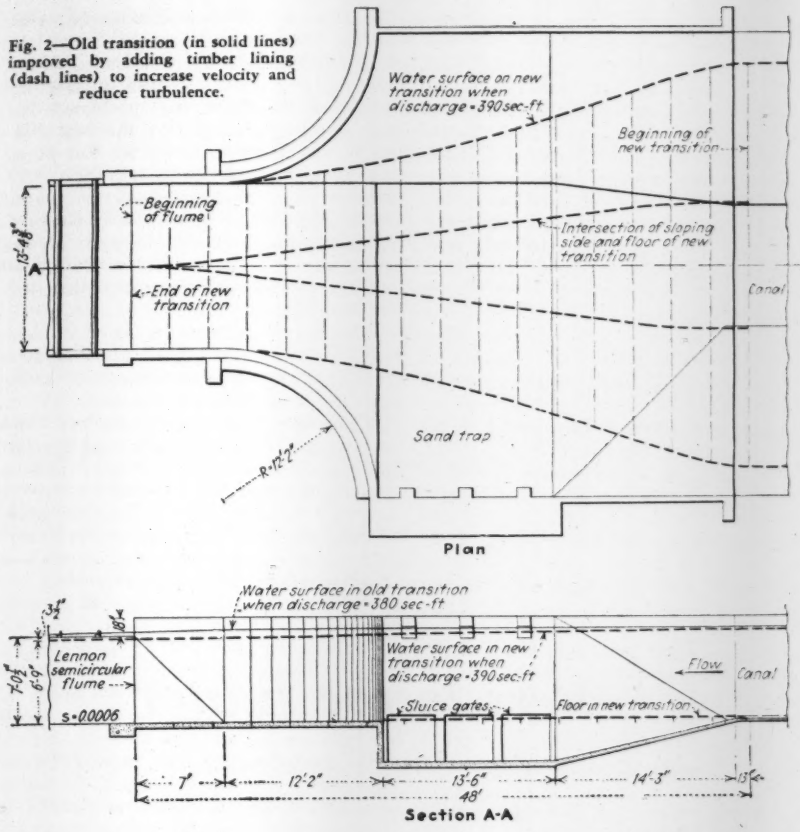


Fig. 2—Old transition (in solid lines) improved by adding timber lining (dash lines) to increase velocity and reduce turbulence.

pear on the sides of the flume, about the size of a 25c. piece and extending as much as ½ in. from the flume surface.

The canal makes an 8-deg. turn, beginning 150 ft. above the flume intake and strikes a tangent again 50 ft. from the entrance. A timber bridge has been constructed across the canal 60 ft. upstream from the flume with a double row of trestle bents which present a definite obstruction to flow. Immediately below the bridge the canal section widened out appreciably to accommodate a sand-trap structure. Not only did the sides of this trap give a greater cross-sectional area but, in addition, the bottom of the canal was depressed 3 ft. to provide a place for the sand deposit. Beginning at the bridge, the bottom of the canal sloped sharply for 14¼ ft. (Fig. 2) and then flattened out for a distance of 13½ ft. The depressed floor rose vertically at the end of the sand trap to the level of the bottom of the flume. A distance of about 20 ft. remained in which the water in the canal had to be accelerated to produce uniform flow in the flume. The sides of this transition were curved and merged into the flume section by means of a short warped section (Fig. 1). This warped section had a distinct break in alignment at the entrance to the flume.

Operation of the entrance transition has been decidedly unsatisfactory. Observations showed that the curve caused higher velocities on the outer bank of the canal and that the bents of the bridge resulted in considerable turbulence. Below the bridge the velocity was decreased materially on account of passing through the sand trap. Turbulence created at the curve and by the trestle bents was increased as the water passed through the sand trap. Upon reaching the transition proper the water surface began to drop, but the distance was so short and the turbulence so great that a full drop could not be obtained before it reached the flume. As a result, water level at the entrance was higher than required for uniform flow in the flume. This resulted, during capacity operations, in the water surface striking the horizontal structural steel angles across the top of the flume, resulting in a skimming action (Fig. 3). Development of uniform flow to the capacity of the flume was not obtained for a considerable distance below the entrance, and meantime an appreciable volume of water was spilled over the sides.

The quantity of water that could be transported through the flume without spilling was 360 sec.-ft. This could be crowded up to 380 sec.-ft., but the loss of water over the sides of the flume amounted to from 10 to 15 sec.-ft. under such conditions.

Revised transition

Before attempting to design a new transition, a study was made to determine the safe flow in the flume, assuming good entrance conditions. In making this study, Bakhmeteff's "Hydraulics" was found to offer a quick and simple solution, using an application of a plan consisting of drawing two relatively simple curves. One of these curves is

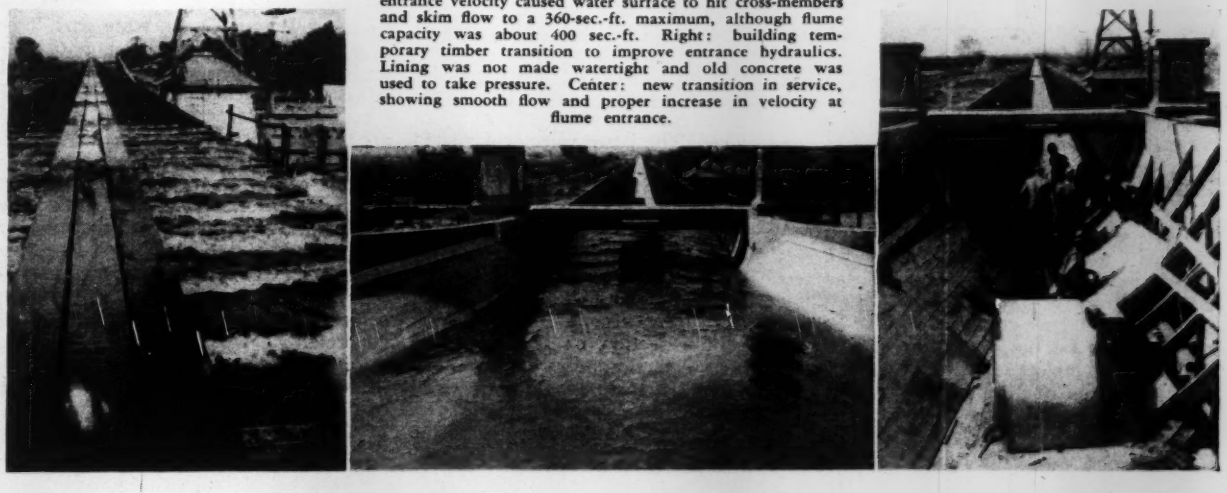


Fig. 3—Left: flume under old conditions, where insufficient entrance velocity caused water surface to hit cross-members and skim flow to a 360-sec.-ft. maximum, although flume capacity was about 400 sec.-ft. Right: building temporary timber transition to improve entrance hydraulics. Lining was not made watertight and old concrete was used to take pressure. Center: new transition in service, showing smooth flow and proper increase in velocity at flume entrance.

nothing more than a discharge curve for various elevations of water in the flume, using known coefficients in Kutter's formula. A value of $n = 0.01355$ was used for the flume, as determined by Fred C. Scobey in tests made on the structure during 1929. The second curve is termed the entrance-discharge curve and is obtained by computing the discharge in the flume from assumed differences in head between the water-surface elevation in the flume and in the canal, using a constant depth in the canal equal to the depth that will obtain with the canal full. Allowances were made for entrance losses in the transition section. A point where these two curves intersect determines the discharge in uniform flow, and was found to be 390 sec.-ft. with a freeboard of 3½ in. in the flume.

In making the design for the entrance transition the method outlined by Julian Hinds ("Transactions, Am.Soc.C.E., 1928") was used, which requires that the drop in water surface between the canal and the flume must be made gradually and without creating disturbances. The total drop in water surface is computed by adding 10 per cent to the velocity head loss, provided that certain assumptions relative to length of transition and maximum change in direction of the water are not violated. It was assumed that the water surface takes the shape of a double parabola. The velocity at any point in the transition is obtained from the difference in head between water surface in the canal and the point in question. When the velocities are obtained it is easy to determine the cross-sectional area at any point, since the discharge is also known. No difficulties were experienced in computing the hydraulic properties of the transition, as there was plenty of head available to produce the desired increase in velocity and to take care of friction losses.

A more difficult problem was involved in determining the cross-sections at various points in the transition. Ideal cross-sections could not be obtained, since the existing concrete structure could not be corrected. An effort was made, however, to keep smooth unbroken lines throughout the transition.

Construction of the transition was necessarily of a temporary nature, as funds were not available for building a permanent structure. Wooden templets were cut to conform with the design of the new cross-sections for the various stations along the transition. These templets were accurately placed, braced and tied down to the concrete structure to overcome buoyancy. No effort was made to construct a watertight structure, as the old concrete walls were to be used to take the pressures. After placing the templets, they were covered with a sheeting of ⅝-in. redwood planks (Fig. 3). The total cost of this transition was less than $500.

At the beginning of the irrigation season a maximum flume capacity is not required. During the spring, however, the flume has been carrying flows of 300 to 340 sec.-ft. Measurements show that the discharge through the flume has been considerably better than anticipated, which would naturally follow from the fact that the lining is smoother now than it will be later in the season. Of particular importance is the observation that the water passes quietly from the canal to the flume with a satisfactory drop in water surface (Fig. 3) and without turbulence at the entrance. The full drop of the water surface takes place by the time the water reaches the flume, which was the principal purpose of the new transition. It appears entirely possible that 400 sec-ft. can be put into the flume without difficulty. This will result in a net water saving of 40 sec-ft. for not less than four months, which represents a value of $10,000 annually to the district.

While an entrance transition is an apparently small item, observations in the present case show conclusively that a few minor details are an important factor in the capacity of a flume. Many felt that the transition was satisfactory and that the flume was to blame, but the results indicated that the real difficulty was in the transition. The flume would act as designed if the water reached the required velocity at the entrance. When grades are flat and capacity discharge is essential, special care should be taken in the design of all minor features of the structure such as transitions.

The state certification board of Arizona is composed of the attorney-general, the state superintendent of banks and the state highway engineer. T. S. O'Connell is state highway engineer, and it was under his direction that the author made the studies outlined. Details of construction for the new transition were prepared by John P. VanDenburgh, district engineer of the Roosevelt Irrigation District, and the new structure was built under his direct supervision.

Letters to the Editor

Cement Composition

Sir—Editorial comments on my article on "Concrete Pavement Failures Due to High Lime Cements," which appeared in the issue of Feb. 16, and comments made on Mr. Bates' article on cements in the April 27 issue need further clarification.

The New York state department of public works has been using cements manufactured by 42 plants in the East. Since 1910 there has been a gradual increase in the tri-calcium silicate content of the cements produced by 41 of these plants. Only one plant has maintained the same high level in the percentage of this constituent throughout this period of over two decades. The average life of a large mileage of concrete pavements constructed with the high tri-calcium silicate cements produced by this one company since 1910 has only given us about seven to eight years of service. On the other hand, we have splendid examples of sound concrete pavements which have given us about twenty years of service. The latter were constructed with practically the same aggregates and low tri-calcium silicate cements.

A very interesting talk on the relation of certain chemical and physical characteristics of cements to the qualities of concrete was delivered last November by Mr. W. J. D. Reed-Lewis, research director, Super Cement Co., before the metropolitan section of the American Society of Civil Engineers in New York City. In this paper Mr. Lewis stressed the chemical and physical characteristics of cement, with special reference to the tri-calcium silicate and di-calcium silicate compounds. The hydrolysis of these two compounds with the relative amounts of lime liberated can usually be tied up with the question of durability of concrete, in so far as materials are concerned.

Mr. Lewis states, "In the process of hydrolysis the tri-calcium silicate liberates three times as much lime as does the di-calcium silicate. It may well be a matter of some concern as to whether the lime liberated is a desirable constituent of concrete or not. It seems very unlikely that it has any cementing value, certainly it is the most readily soluble substance in concrete and, with few exceptions, in cases of serious deterioration, the free lime in the concrete seems to have been the first point of attack."

Other investigators, such as Lili in the paper he presented before the Congress of Italian Court, state that low-lime cements have the advantage of producing less shrinkage, less internal stress, higher tensile strength and equal compressive strength at later ages and are thus more resistant to disintegration, Probst states that low-lime cements resist the action of sea water better than other cements. Exposure is more severe in pure water, and low-lime cements are important. Green, in "Der Bauingenieur," on the solution phenomena of concrete, suggests the use of low-lime cements to resist the deterioration of concrete.

In my study on concrete pavements in New York State I find the question of durability reflects itself in the quality of the mortar (sand and cement), provided engineering practices, such as de-

sign, workmanship, water-cement ratio, etc., etc., have been properly carried out. While I consider the latter factors important, a considerable number of failures that have occurred in New York State can be traced directly to the quality of the fine aggregate and type of cement used. By type of cement I have reference to the high- and low-lime cement, with particular emphasis on the percentage of tri-calcium silicate compound present in the cement.

Concrete made with the same aggregates and cements varying in compound composition will produce concrete of different durability. Such sands as are highly absorptive and most generally break down in the magnesium sulphate accelerated soundness test, but do not exhibit this property in the sodium sulphate soundness test when combined with high-lime cements, will produce less durable concrete than when combined with low-lime cements. On the other hand, such sands as are low in absorption and as a result usually give small losses in the magnesium sulphate soundness test, when combined with high-lime cements, produce concrete of practically the same durability as when combined with low-lime cements. In other words, concrete made with poor sands will give varying degrees of durability depending upon the type of cements used. With cements as are now produced by the industry here in the East, the results obtained with some sands give very unsatisfactory results. With high-quality sands present-day portland cements give fairly good service.

In studying the durability of concrete pavements I find that the percentage of tri-calcium aluminate in cements is not as important as the percentage of the tri-calcium silicate compound. Although I would like to see the tri-calcium aluminate compound kept down as low as possible because of its chemical and physical characteristics, my studies have led me to believe that the percentage of this constituent present in our cements in the East does not materially affect the durability of concrete pavements. Our cements vary from 7 to 16 per cent in tri-calcium aluminate. However, I do believe that this constituent in cement should be kept as low as possible in mass concrete on account of the large amount of heat liberated by this compound. In concrete pavements the cross-section of the structure is comparatively thin, and on account of the large surface area exposed the heat generated by this compound is dissipated in a short period of time.

I note in Mr. Bates' article that the cement used in the concrete upon which the Statue of Liberty stands contains by calculation 10 per cent more tri-calcium silicate than di-calcium silicate, and that the alumina content is ⅛ more than the 6 per cent so frequently indicated as the upper limit for cement used in contact with sea water. Here is another instance where the quality of the sand used in the structure plays an important part in the question of durability. In that locality we have excellent sands, and there is no doubt in my mind that a sand containing a very high percentage of quartz was used in the concrete.

My investigation of the type of cements used 40 or 50 years ago leads me to believe that some "natural" cements, such as Brooklyn Bridge Rosendale, were used with success. Although such cements were slow in gaining their strength, they have withstood the acid test of time. It is interesting to note their chemical composition and, in the light of our present-day knowledge, their compound composition. A typical chemical analysis of Rosendale cement is as follows:

SiO_2	27.55
Al_2O_3	4.22
Fe_2O_3	4.40
CaO	34.40
MgO	19.94
SO_3	1.37
Ignition loss	7.48
Undetermined	0.64

which, when calculated on a basis of the compound composition, shows:

$CaO.SiO_2$ (mono calcium silicate)	52.35
$3CaO.Al_2O_3$ (tri-calcium aluminate)	3.73
$4CaO.Al_2O_3.Fe_2O_3$ (tetra calcium alumina ferrite)	13.5
$CaSO_4$ (calcium sulphate)	2.33

IRA PAUL,
Associate Laboratory Engineer,
N. Y. State Dept. of Public Works.
Albany, N. Y.,
April 28, 1933.

Cold-Driven Rivets

Sir—In your issue of June 15, 1933, p. 784, there apears a headline that I feel should not pass without comment. The statement that cold-driven rivets are superior to properly heated hot-driven rivets is not so conclusive as it sounds. The effects of overstrain in steel are well known, and they may be beneficial under certain circumstances, but in regard to rivets the advantages are not all on the side of those driven cold, as would appear from the article.

It should perhaps be recalled that ferrous metals, when severely overstrained, corrode more rapidly than when heat-treated or hot-worked. In some cases of riveted joints this increased tendency to corrode may be of importance. Overstrain is advantageous chiefly for static stresses and may be quite injurious where dynamical effects have to be considered, especially at low temperatures. On the other hand, where high temperatures are involved trouble may arise from grain growth and the promotion of caustic embrittlement, both of which are associated with overstrain in mild steel.

As interesting as the records of these tests are, considerable work still remains to be done in testing cold-driven riveted joints before any appreciable increase in allowable stresses should be adopted generally, and even then care must be taken to be certain that conditions suitable to severely cold-worked material exist at all times in the structure.

I. F. MORRISON,
Professor of Applied Mechanics,
University of Alberta.
Edmonton, Canada,
June 28, 1933.

Earthquake-Code Requirements

Sir—Your editorial headed "A Law for Earthquake Safety," in the issue for June 1, 1933, was apparently hastily written without a careful study of the act or a knowledge of its purpose. It is misleading and, to those who do not understand the effect of the law, it will appear that the horizontal forces provided are sufficient to insure safe construction in all parts of California, and that structures built in the more favored sections of the state will be unnecessarily strong.

Earthquakes have occurred in all parts of California and are to be expected again, and the horizontal force of 2 per cent of the vertical load is considered much too small, even for a minimum requirement, by most of the engineers who have studied the problem. The wind force of 20 lb. per sq.ft., rather than the 2 per cent of the vertical loads, will govern the design of most buildings.

The code now before the city of Los Angeles for adoption provides for a horizontal force of 8 per cent on all buildings, and the proposed new city building ordinance for San Francisco, on which a committee of competent structural engineers has been at work for over four years, provides for horizontal forces of 2 to 10 per cent of the vertical loads, depending on location and type of structure. Some California cities have ordinances more severe than these, and it is expected that the committee working on a uniform state-wide code, under the auspices of the California State Chamber of Commerce, will adopt percentages at least as large as those in the proposed San Francisco code.

Engineers do not expect the new state law "to affect present practice and building costs extensively," nor do they expect it to be "burdensome," as any moderately well-built building will probably meet its requirements.

ERLE L. COPE,
Consulting Engineer.
San Francisco, Calif.
June 10, 1933.

SUPPORTING historical evidence confirms Mr. Cope's statement that strong seismic disturbances have occurred and can be expected to reoccur in practically every part of the state of California. However, this occurrence at only about 100-year intervals in some parts of the state should be taken into consideration in designing buildings for a 40- or 50-year life. Regardless of any cost increase that might result from the law or even from a more stringent one, there was no intention in the editorial to compromise with sound construction. Obviously, adequate design and construction based on the best engineering principles and judgment must be controlling.—EDITOR.

Engineering News-Record

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Editorial and Publishing Offices at 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, England.

Subscription price $5 per year in the United States; foreign rates on application.

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July 27, 1933 Volume 111 No. 4

A Foundation Still Needed

BUSINESS, according to the National Industrial Conference Board, has regained 40 per cent of the ground lost between June, 1929, and March, 1933. The news is gratifying, but it is no cause for elation. Some ten million men are still unemployed. Prices have gone up, and wages are lagging. Although heavy construction has increased unseasonally, it accounted for less than half a billion dollars in contracts during the first six months of the year. Steel is doing well, but is living on sheet and tin-plate orders, born of fear of inflation. The huge industrial load that cheers the electrical utilities can also be traced too largely to feverish manufacturing for inventory before material prices and wages go up. Recovery so far, being based almost wholly on hope or fear, is highly unstable. The actions of the stock and grain markets recently are illuminative in this regard. Until a true foundation of purchasing power from widespread employment becomes a fact, this instability must remain. And unless public-works contracts are let very soon the employment gains made to date may be lost. Now is the time to apply the pressure to public-works construction.

Fabricated Structural Timber

AN ADDITION to engineering terminology is in the making if practices used on the timber railway bridges in Washington, as described in this issue, become general. Such a development would suggest the use of the term "fabricated structural timber," because the practices to which the bridge members were subjected closely parallel familiar practices in connection with fabricated structural steel. Anyone reading the article on the bridges will be impressed with the engineering precision of the design, with the careful shop work and with the conscientiousness with which the erector followed detailed plans, even to building a model to guide his men in assembling the trusses. Heavy timber construction has been elevated to this relatively high plane by virtue of two rather recent developments, both resulting from initiative on the part of lumber manufacturers. In the first place grade-marking of lumber has removed the uncertainty concerning uniformity; designers accordingly do not need to use extra-conservative working stresses as they have had to do with a non-uniform product. In the second place, ingenious joint designs, termed "modern connectors," have been borrowed from European engineers, which go far to remove a limitation on the capacity of joints that depend solely on the bearing resistance of wood on a metal bolt. These joints utilize dowels or bushings set in countersunk holes in the faces of timber members, which carry a large portion of the load in shear. Framing of members using such joints naturally requires accuracy of fabrication-shop proportions. With design put on a precision basis, and with fabrication and erection subjected to similar improvements, the term "fabricated structural timber" may soon be accepted as connoting efficiency, economy and good workmanship.

Is Chiseling to End?

IF THE industry rehabilitation and reform that is a primary aim of current governmental efforts is to have practical meaning, bid chising must be checked quickly and firmly. That is obvious to all who have followed the course of events in the markets of industry during the last two years. Accordingly, the early success of the industry-control provisions of the Recovery Act will be measured by what it accomplishes in checking this practice. Most immediate results should be expected in governmental buying, for here the public purpose should find fullest and speediest expression, the more so as the size and importance of governmental purchases give them a controlling influence over current marketing practices. The recent cases of forcing down prices by two separate authorities—the federal government as to cement for Boulder Dam, and the government of Illinois as to state highway cement—are therefore strongly discouraging. Progress can be expected only if chiseling is ended everywhere, in government as well as in private practice.

New Dredging Process

AGITATION dredging, which has been introduced into the process of enlarging the channel of the Atchafalaya River, as described in this issue, is a new technique in channel deepening. In general it is directly in line with the theory being put in practice in the new plans for this troublesome stream of employing the dynamic energy of the river to do its own channel regulating. Specifically, it is based on the principle that a flowing stream is able to transport a greater volume of detritus in suspension and by bottom drag than it can erode from its banks and bed. It is the function of agitation dredging to supply the eroding action, to loosen the bed material, break it into fine particles and distribute it, greatly diluted with pump water, into the river current. This current is then expected to carry the solid material down river to reaches where its deposition will do no channel damage as, for example, into the deep water below Natchez on the main river or into the broad reaches of Grand Lake on the Atchafalaya. The plan is both bold and ingenious, and the methods are exceedingly simple. Their success is a fact to be discovered as the work proceeds to a stage where definite determinations are possible.

An Invention in Blasting

A DEFINITE development in methods of rock excavation in deep water appears to have been made by the contractors for the foundations of the Golden Gate Bridge. As described in this issue, the new method is reminiscent both of familiar drill-boat blasting and of rock-breaking with chisels, as most prominently represented by the Lobnitz rock-breaker. It, however, appears to surpass both older methods in depths of water in which it is efficient; indeed very great depths are the especial province of the method. At the Golden Gate Bridge the depth of water was from 50 to 80 ft., and in

the deepest water no difficulty in operation was experienced that was a material obstacle to the process. As they are described, it will be noted that procedure and effect are quite different from ordinary surface bombing; they are more nearly similar to the action of an armor-piercing explosive projectile. Penetration by force of the explosive bomb is an essential element of the process. In the case of the larger bombs, particularly, the exploding charge is virtually fired into the rock, only the propulsive force and velocity being essentially different from cannon fire. This projectile action places the new blasting method in a category of its own and materially extends blasting practice in construction.

Higher Wages, Fewer Hours

PRESIDENT ROOSEVELT'S plea to all industry for an immediate increase in wages and a shorter shift should have taken no one by surprise, least of all anyone in the construction industry where roadbuilding has been on a short week and a living-wage pay basis for some time. Some four weeks ago General Johnson in a radio address quite specifically laid down the program, which it has now been necessary for the President to urge upon all industry. He said, "What you should do—what every man who employs another man should do, no matter in what business—banking, commerce, manufacturing, law, mining, everywhere—is to begin to plan how you can split up that work to cut down your workers' time to put more men on the payroll and to pay a living wage for a shorter shift."

The construction industry—engineers, contractors and manufacturers—has every reason to back the President in his recovery program. It has been chosen as the key industry in the Administration's prosperity drive. It is slowly learning that in normal times as well as in emergencies the workmen must be given a greater share of the profits, that they must be more steadily employed. It knows that it must absorb the greater proportion of the ten million or so unemployed, and that the three billion dollar public-works program plus the two billions of contracts outside of the program in 1933 will not do this if each man is to be given the usual 50 or 60 hours of work per week. The contractors have signaled their intent to subscribe to the President's program in their code, submitted two weeks ago. They and the other elements of the industry are now faced with the problem of putting the wage and hour provisions of such a code into effect by August 31. Only in exceptional cases is there reason to believe that it cannot be done.

No engineer or contractor who has undertaken a job since the National Industrial Recovery Act went into effect should have undertaken it unless he knew it could be carried forward profitably at rates of pay and hours corresponding to those now suggested. On these jobs the obligation of higher wages and shorter hours can immediately be assumed. Manufacturers serving the construction industry have already in many instances raised wages; those who have not can probably do so by cutting profit margins. In many instances of course they have already subscribed to codes that provide for the shorter shift and a living wage. Contractors who are working on jobs that they took on a lump-sum bid eight months to a year ago, are in a more difficult situation. If they bid enough originally to offset rising prices they are in a position to increase wages. If their profit is assured, they can trim it in favor of wages. If they are already worrying to break even, their decision is hard indeed.

The National Industry Recovery Act was written for the working man. The credo of its backers was purchasing power, not profits. There has been a tendency to forget that, even on the part of some of the code drafters, who have assumed that it was meant to put business back on the 1926-29 basis, where profits far outran wages. Every move that has originated in Washington has tended to reverse that order. The working man is to be resurrected first. His buying power is to resurrect business, to health but not to affluence. The President's blanket code for all industry serves to remind the nation again that it is wages in which we are interested. The only difference between his present statement and others is that he says that next month is the time to begin.

In general, starting to pay living wages and to work fewer hours on August 31 will cause little hardship. It means anticipating the codes only a few weeks. And it may mean the difference between success and failure in our efforts toward recovery.

A Social Experiment Starts

THE Tennessee Valley Authority was set up with the frankly expressed purpose of trying a large-scale social experiment. Details were lacking when the act was passed, but now that the three men who are to constitute the Authority are hard at work the plan is beginning to take form. The experiment is to start at the Cove Creek Dam in the Tennessee mountains. Under the terms of the act either the army engineers or the bureau of reclamation might be designated to build the dam. Both are organized to undertake the work quickly. Now, however, its construction has been transferred to the Tennessee Valley Authority, and it is to be built—apparently on a force-account basis—by labor recruited from the surrounding region. These men will work on the dam only thirty hours a week; the remainder of the normal working day will be devoted to manual training in trades with which they are unfamiliar or to other work of an educational nature. On this basis construction of the dam is expected to take five years to complete.

This proposal is reminiscent of the methods of teaching employed at Antioch College, of which Arthur E. Morgan, chairman of the Tennessee Valley Authority, is president. It also fits in logically with the ideas of those who fostered the legislation, but it will be disappointing to those who saw in the $30,000,000 Cove Creek Dam a big construction project that could be put under way quickly and prosecuted intensively to help stimulate industry generally. If, however, the public-works section of the Recovery Bill is made productive soon, this may not be so serious a loss.

From another viewpoint, however, there is reason to question the slowing up of construction of Cove Creek Dam. As a great storage reservoir it is the key to increased power at the Muscle Shoals hydro-electric plant. If the Valley Authority finds itself in need of more power for the other operations that it is expected to undertake, then it may well wish that the lesser experiment at Cove Creek had been sacrificed to advance the day when water stored behind Cove Creek Dam would make possible the generation of more firm power for the larger experiment in the lower part of the valley.

NEWS OF THE WEEK

Regional Heads Designated for Public Works

THE TEN regional advisors to the public-works administration were appointed by President Roosevelt Wednesday. Their duties are to represent the administration in the various regions, each composed of several states, and to consult with state advisory boards, soon to be appointed, to the end that selection of projects may be consistent with sound local and regional planning. In addition, the regional advisors will keep the national planning board, also named this week, advised of developments. The regional advisors, it is stated, will not exercise any actual authority as all projects selected by the state committees will be forwarded direct to Washington. They will serve, however, as the representatives of Secretary Ickes in speeding up the work and in investigating such problems as may arise.

In announcing the selections Secretary Ickes stated that all non-federal projects, public or private, are to be presented by their sponsors to the state advisory boards. According to Secretary Ickes, each regional advisor will visit the offices of the state boards within the region and advise and consult with these boards from time to time.

The administrators for the ten regions, all of whom have been chosen from outside the construction industry, are as follows:

Region 1. Ralph L. Cooper, of Belfast, Me., with headquarters at Boston. Mr. Cooper is a business man and former member of the Maine legislature.

Region 2. Edward J. Flynn, present secretary of state of New York, with headquarters in New York City.

Region 3. Daniel J. Tobin, of Indianapolis, with headquarters at Chicago. Mr. Tobin is a labor leader and former treasurer of the American Federation of Labor.

Region 4. Frank Murphy, of Wheaton, Minn., with headquarters at Omaha. Mr. Murphy is president of the Minnesota State Bar Association.

Region 5. N. Dana Marshall, editor, *The Portland Journal*, with headquarters at Portland.

Region 6. Justus S. Wardell, with headquarters at San Francisco. Mr. Wardell was in the internal revenue bureau during the Wilson administration.

Region 7. Clifford Jones, of Spur, Tex., with headquarters at Fort Worth. Mr. Jones is president of the Texas technical college board and a director of the Fort Worth & Denver Railroad.

Region 8. Vincent M. Miles, Fort Smith, Ark., lawyer, with headquarters at Kansas City, Mo.

Region 9. Monroe Johnson, of Marion, S. C., with headquarters at Atlanta. Mr. Johnson is a business man active in the American Legion.

Region 10. George L. Ratcliffe, with headquarters in Richmond. Mr. Ratcliffe is a lawyer and banker and was formerly secretary of state in Maryland.

Construction Code Being Considered To Cover All Elements of the Industry

In line with its policy to reduce the number of codes to a minimum, the National Recovery Administration has asked the construction industry to submit a basic code that will cover all of its operating elements. The request, which was made to the Construction League as the organization most representative of all the divisions of the industry, followed the submission of codes by the general contractors (*ENR*, July 20, 1933, p. 82) and also by some seven different subcontracting groups. In addition, there was the possibility of both architects' and engineers' codes. So many codes from a single industry were deemed unnecessary, and the request for a general code followed.

The first official move in the matter was made on Wednesday of this week when Malcolm Muir, deputy administrator, met with the policy committee of the Construction League to lay the groundwork for the task of drafting the code. Stephen F. Voorhees, architect, New York City, is chairman of the code committee of the Construction League of the United States.

Emergency Employment Service To Fill Public Works Jobs

The creation of an emergency organization to care for the orderly and efficient selection of applicants for work on highways and public works to be constructed with the funds made available under the Public Works Act was announced by the United States Employment Service of the Department of Labor on July 19. The new organization, designed to be temporary in character, will be known as the National Reemployment Service. The present Director of the United States Employment Service, W. Frank Persons, is to be director of the new service. State directors of reemployment have been appointed in each of the states.

The labor policy adopted by the public works board includes the following provisions:

"Opportunities for employment on projects authorized under its administration shall be equitably distributed among qualified workers who are unemployed, not among those who merely wish to change one good job for another;

"These work opportunities shall be distributed, geographically, as widely and as equitably as may be practicable;

"Qualified workers who, under the law, are entitled to preference shall secure such treatment;

"The wasteful costs and personal disappointments, due to excessive migration of labor in quest of work to the vicinities of projects, should be avoided;

"Local labor required for such projects, and appropriately to be secured through employment services, should so far as possible be selected from lists of qualified workers submitted by local employment agencies designated by the United States Employment Service."

It is the clear understanding of the Department of Labor that highly skilled and organized labor is not to be required to register for work at reemployment offices but will be recruited in the customary ways.

In each state the reemployment organization will be set up to supervise the agency in that state. Such state organizations will consist of a state director of reemployment, and one or more field representatives, the latter supervising the local reemployment agencies. Advantage is to be taken of the registrations for work already made by relief agencies, but the local placement offices will afford full opportunity for the orderly and complete registration of all unemployed, whether or not they have been registered through relief committees

Louisiana to Build Bridge Over Bonnet Carré Spillway

Construction of the highway bridge spanning the Bonnet Carré spillway at an estimated cost of $1,200,000 will be provided by the federal public works allotment of $5,828,591, according to the Louisiana Highway Commission. It is anticipated that this project will be among the three or four to be advertised immediately. The bulk of the funds advanced for the highway work will be utilized to close gaps in the paved highway system, and for the erection or re-construction of bridges. Elimination of narrow bridges erected prior to the increase of traffic to its present volume is provided.

Vermont Highway Commission Named Public Works Board

The Vermont legislature, sitting in special session, on July 20 named the state highway commission as a board of public works to operate under the national recovery act. The board consists of George Z. Thompson, chairman, Emery A. Melendy and R. E. Farwell. Hubert E. Sargent is chief engineer. The legislature also appropriated funds for rights-of-way and necessary titles for the construction of flood control works on the Winooski River. A special unit of the C.C.C., all veterans, will construct the works under the direction of U. S. Engineer Corps. Construction has started on an earth dam near East Barre, Vt. At least one more earth dam will be built and work will be done in clearing out the river channel where necessary to provide free flood flow.

Public Works Board Next to Consider Larger Projects

(Washington Correspondence)

FOLLOWING allotment of $21,377,648 for a variety of small federal projects, bringing the total up to $85,939,190, the public works board turned this week to consideration of large federal projects and some of the larger projects pending in the R. F. C. portfolio when its program was terminated. Secretary Ickes stated that no flood control or river and harbor work is included in the list now being studied by the board and that such work has been referred to the Budget Bureau for recommendation. It is still expected, however, that this will constitute the major element of expenditure for public works. A coordinated program of development in the Mississippi valley is referred to by Col. Henry M. Waite, deputy administrator, as the "white hope" of the public works program because it "offers an opportunity to spend the money as it ought to be spent."

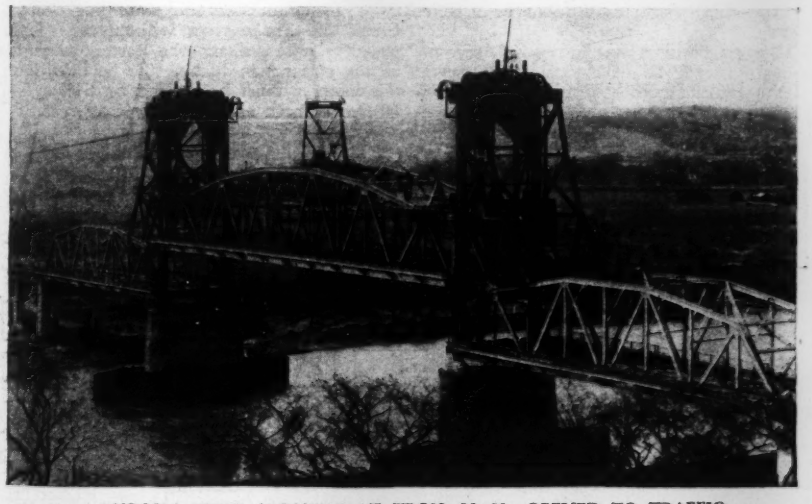
A planning board organized to study the long-range possibilities and effects of public works construction from a social and economic viewpoint, will hold its first meeting in Washington on July 30. The inquiry will cover all types of work that may be undertaken by federal and local governments and private enterprise under the law. The planning board will maintain contact with regional advisors and state boards for the purpose of coordinating projects that may be included in the public works program with an eye to future development. The members of the board are Frederick A. Delano, formerly associated with the New York regional planning group; Wesley C. Mitchell, Columbia University economist; Charles E. Merriam, of the University of Chicago. Charles Eliot, 3d, will serve as executive secretary of the board.

A housing division of the Public Works Administration has been organized under Robert D. Kohn, former president of the American Institute of Architects. N. Max Dunning, previously associated with the R. F. C., is assistant director and Eugene Henry Klaber, Chicago architect, will head the technical staff. Consultants, as needed in the field or in Washington, will be called in as required on a per diem basis. Consultants so far designated include Henry Wright, of New York; Mrs. Edith Elmer Wood, of New Jersey; F. L. Ackerman, of New York; Jacob Crane Jr., of Chicago; Russell Black, of Princeton; Coleman Woodbury, of Chicago; Harold D. Hynds, of New York; and Tracy Augur, of Detroit. Coordination of housing projects planned in various sections of the country will be directed by Howard Green, of Cleveland, Alfred K. Stern, of Chicago, and Mrs. Mary K. Simkhovitch, of New York, also to be retained on a per diem basis as occasion requires.

The public works board has adopted a policy of preference for local labor and local materials in local projects, so far as it is practicable. This will not apply if higher costs are involved. Selection of local projects will be made largely with a view to relieving unemployment.

Projects that had been approved by the R. F. C., but to which no funds had been

(Continued on p. 119)



HUDSON RIVER CROSSING AT TROY, N. Y., OPENED TO TRAFFIC

The Troy-Menands Bridge over the Hudson River which was opened to traffic on July 17 is a duplicate of the new bridge at Albany with the exception that the towers are shorter, giving a vertical opening for the lift span of only 77 as compared with 99½ ft. The lift-span is 341 ft. long flanked by 225-ft. tower spans. Silicon steel is used extensively in the lift-span which weighs 2,730 tons exclusive of the counterweights. A 6½-in. concrete deck with a bituminous wearing surface is used on the lift span which is operated by two 250-hp. shunt-wound electric motors located at the center of the span and supplied with current from a large motor-generator set. A standby unit consists of a 180-hp. 6-cylinder engine.

The bridge was built by the New York state department of public works under the direction of Frederick Stuart Greene, superintendent, T. F. Farrell, chief engineer and H. O. Schermerhorn, assistant chief engineer with Oscar Hasbrouck in charge of the construction. Waddell & Hardesty were retained as consulting engineers to design the superstructure. McDonald-Spencer Engineering Co. had the contract for the foundations and the Phoenix Bridge Co. for the superstructure.

Further Study Recommended For Upper Missouri Waterway

Colonel George R. Spalding, who supervised the study of the proposed Upper Missouri River deep-water channel, has submitted a report to Major General Lytle Brown, Chief of Army Engineers, recommending that further investigation be made of the project before the construction work is authorized by the department. He expresses doubt that there is sufficient water in the upper stretches of the river during a long period of low water to provide for safe navigation. He said that a most careful study should be made to ascertain whether a commercially navigable channel up to Sioux City, Ia., is practical and warrants the expenditures needed.

Upper Missouri River advocates have suggested a storage dam in the upper reaches of the stream. Colonel Spalding estimates such a dam would cost at least $75,000,000 and that probably as much more would be needed to provide a deep-waterway to Sioux City.

Chicago Reports Little Work Done on Sewage Plants

For the six months ending July 1, the report of the Sanitary District of Chicago to the Supreme Court indicates little construction work has been done. On design, work has been diligently pursued on the Calumet, West Side and South Side projects. The design force was doubled in March and April to get plans and specifications ready for a sizeable program anticipating federal financing.

The operation of the sludge filtering and drying unit at the West Side Works since August, 1932, has demonstrated the feasibility of dewatering and incineration for the disposal of sludge to such an extent that the board has adopted this method for future plans. It permits building the entire Southwest Side plant on a portion of the West Side plant site already owned.

Contract plans are under way for aeration tanks, operating galleries and final settling tanks for the activated-sludge portion of the West Side Works. The first contract will be for a 600-m.g.d. plant. Plans are under way for blower house and sludge-return pumping station for the combined West Side and Southwest Side activated-sludge plant. Change of site location reduces the Southwest Side plant to a pumping station, screening plant and preliminary settling tanks.

The local tax situation is reported as improving but of the total taxes, $85,820,000 for 1928, 1929, 1930 and 1931, 36 per cent still remain unpaid. The percentages unpaid for the respective years are 21.6, 27.5, 38.5 and 60.0 per cent. Non-payment of taxes has caused defaults as of June 19 of $10,084,500 in principal and $5,333,000 in interest, with $2,430,000 further defaults July 1.

The estimated cost of future work, due for completion in 1938, is $120,367,500 (see *ENR*, June 29, p. 847). The District hopes to obtain federal aid for early resumption of work.

Water diverted from Lake Michigan by the District for dilution purposes for the six months ending June 20 was 5,935 sec. ft. Domestic pumpage of water by Chicago was 1,625 sec.ft.

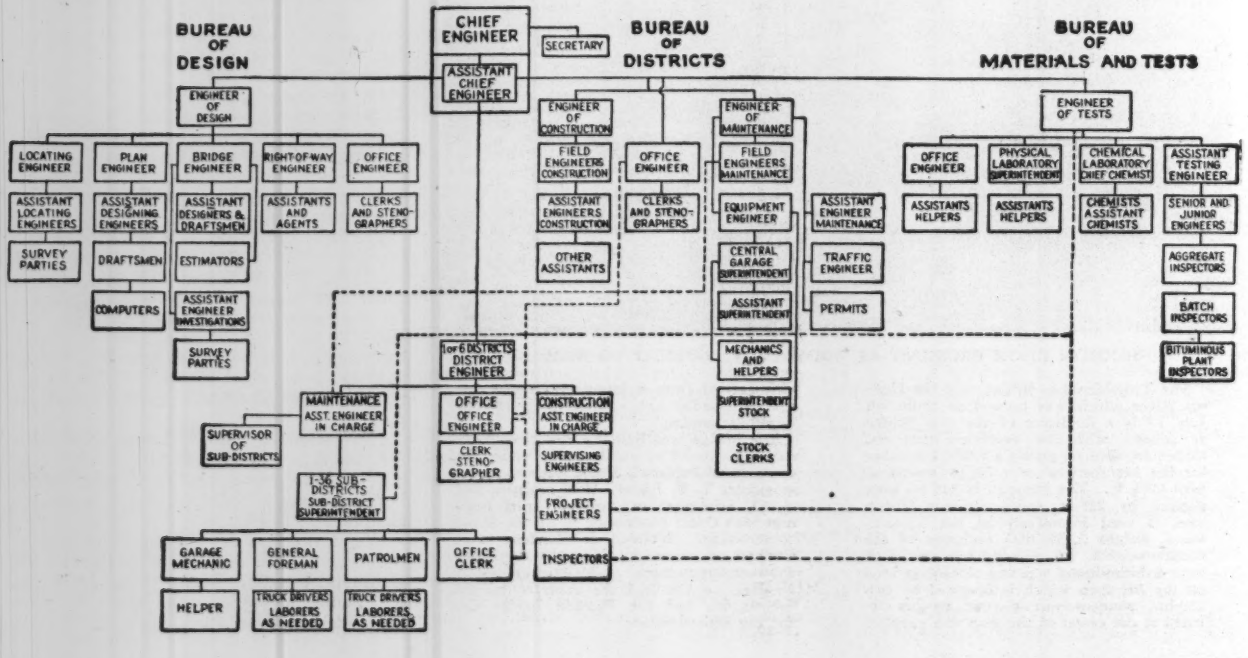
Indiana Highway Department Reorganized Under New Law

A new organizational set-up of the Indiana State highway department went into effect on July 1. Under a new law, a three-man full-time commission replaces a director and a four-man part-time commission. The department becomes a division of a new public works department which is administered by a board consisting of the chairman of the state highway commission, chairman of the conservation commission and the excise director, together with the governor as an ex-officio member.

The new highway commission appointed by the governor abolished all positions in the old department, set up a new organization with somewhat different lines of authority and re-appointed most of the old personnel to the new positions. The basic difference between the new set-up and the old is that the previous centralization in Indianapolis of authority over maintenance and construction is replaced by district supervisors reporting directly to the chief engineer. Under the old organization a construction division and a maintenance division reported to the chief engineer. The construction division for example was divided into departments of roads, tests and bridges and each of these departments had complete charge of its respective work over the state. The new set-up combines road and bridge design in a bureau of design, places tests in a separate bureau and delegates all construction and maintenance work to the six district engineers.

The new organization is shown on the accompanying chart. The principal officers are M. R. Keefe, chief engineer, formerly vice-president of Ulen & Co.; J. T. Hallett, assistant chief engineer, formerly in charge of road design and construction; Fred Kellam, engineer of design, formerly in charge of bridge design and construction; S. G. Cohen, engineer of construction; C. W. McClain, engineer of maintenance and P. D. Miesenhelder, engineer of tests. The six district engineers are: Walter Irick, Crawfordsville district; Roy Biberstine, Fort Wayne district; F. A. Henning, Greenfield district; Oliver Downs, LaPorte district; Ray Bower, Seymour district, and Glen Allen, Vincennes district.

New organizational set-up of Indiana highway department in which construction and maintenance are entirely divorced from design work and testing.



Uniform Vehicle Regulation Sought by Twelve States

Representatives of twelve states and the District of Columbia will meet at Harrisburg, Pa., in October to consider the practicability of reciprocal and uniform state legislation and the regulation of size, weight, height and length of motor vehicles transporting passengers and freight. The conference will be conducted by the American Legislators' Association, which has called it in response to a request by the Pennsylvania legislature. The participating representatives will be from the states of Maine, New Hampshire, Massachusetts, Vermont, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Ohio, Indiana, Illinois, West Virginia, Virginia and the District of Columbia.

Two formal codes are scheduled to be presented to the conference, one adopted by the American Association of State Highway Officials, and the other that adopted by the Automotive Transportation Code Committee of the Society of Automotive Engineers. There will also be presented the informal recommendations of the governor of Pennsylvania. The conference will also consider the studies made by the United States Bureau of Public Roads.

If any agreement can be reached, recommendations will be made to the legislatures of the states represented for the adoption of such legislation.

Bridge Building in California Reopens Furnace in New York

Blast furnaces of the Chateaugay Ore and Iron Co., at Lyon Mountain, N. Y., are to reopen at once to supply pig iron used in the building of the $70,000,000 Bay Bridge and the Golden Gate Bridge, both at San Francisco, Calif. This pig iron is to be used in making cables. The firm furnished similar materials for the George Washington Bridge over the Hudson River.

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded in the United States during the month of June, divided according to roads, streets and alleys, and the total for the first six months of this year:

	Square Yds. Awarded During June, 1933	Total Sq. Yds. Awarded to Date July 1, 1933
Roads	1,546,571	11,445,797
Streets	293,095	1,325,736
Alleys	21,158	84,430
Total	1,860,824	12,855,963

Water-Rights Compact Arranged By Idaho and Wyoming

A compact between Idaho and Wyoming, adjusting the troublesome question of water rights along the Snake and other rivers on the Idaho-Wyoming boundary, has been made public by James B. True, State Engineer. In a general way the compact ratifies most existing agreements for the use of water by irrigationists of the two states, gives Idaho certain storage rights in Wyoming, and to Wyoming the right to administer the water of Teton Creek and Snake river without regard to priority rights along the lower sections of the streams in Idaho. To be effective, the compact must be ratified by the legislatures of both states and by Congress.

Public Works Board Takes Up Larger Projects

(Continued from p. 117)

released cannot be brought before the public works board until the R. F. C. has rescinded its action. Such projects then will be referred to the appropriate state board.

The public works board is formulating its policy with reference to hours of labor and wages but has not yet reached a final conclusion.

The allocation of $21,377,648 for federal projects includes $6,971,648 for 14 post offices in 9 states. These had been recommended by Budget Director Douglas as justifying their cost. Other federal buildings are being carefully considered, said Secretary Ickes, to determine whether they are needed now to save the government money and whether they meet the other qualifications required for projects receiving allotments of public works money. Other allotments were: $851,000 to the Department of Justice for construction and reconditioning of prison buildings in 12 states; $1,000,000 for the Panama Canal Zone for the Balboa high school and junior college building, for commencing construction of Docks Nos. 14 and 15 at Cristobal, for construction of employes' quarters, for beginning construction of a dredging station at Gamboa, and for a new barge at Paraiso; $6,000,000 to the War Department to carry on work at 23 arsenals and ordnance depots which have been on a 4-day week since July 1 and otherwise might have been forced to close; $5,000,000 for allotment to the states by the Bureau of Agricultural Economics for a one-year program of soil erosion control on 792 units of 6,000 acres each; $1,555,000 to complete flood control dams on the Winooski River in Vermont undertaken by the Civilian Conservation Corps. This is described as an emergency allotment independent of other river and harbor and flood control projects.

New York and Utah have been the first states to get actual approval of highway projects to be carried out as part of the public works program. The Bureau of Public Roads has approved detailed plans for eleven road projects in New York and six in Utah. This approval of detailed plans followed the earlier acceptance by the Public Works Administrator of the distribution by the states of their federal highway fund allotment between federal-aid state highways, routes through cities and secondary roads.

The administrator's approval for such distribution for three more states, Minnesota, Arkansas and North Carolina, brought the total of states receiving definite assignments for this purpose to 33 states and the District of Columbia, involving a total assignment of $266,942,038 out of the $400,000,000 allotted to roads in the public works act. To date assignments have been approved for the following states: New York, Ohio, Massachusetts, Utah, Indiana, Kentucky, Oklahoma, Oregon, North Carolina, Vermont, Virginia, Washington, Missouri, Wisconsin, Idaho, North Dakota, Maine, West Virginia, Delaware, Louisiana, Florida, New Hampshire, Montana, Iowa, Texas, Kansas, Nebraska, New Mexico, Tennessee, Minnesota, Arkansas, South Carolina and the District of Columbia.

Frank R. McNinch Named Power Commission Chairman

Acquiescing in the desire of President Roosevelt to have a man of his own selection as chairman of the Federal Power Commission, George Otis Smith resigned his chairmanship of that body on July 19 to make way for the appointment of Frank R. McNinch, who has been vice chairman for several months. Mr. Smith's resignation was only as chairman of the body.

Mr. McNinch's designation as chairman was confirmed promptly by the commission by a unanimous vote, with Mr. McNinch not voting. The commission selected Basil Manly, who was appointed in May by President Roosevelt as vice chairman.

Mr. McNinch, who is 60 years old and a native of Charlotte, N. C., became a member of the commission early in 1931.

SOCIETY CALENDAR

AMERICAN ASSOCIATION OF ENGINEERS, annual meeting, Chicago, Ill., Oct. 3-6, 1933.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Milwaukee, Wis., Oct. 9-11.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual meeting, Chicago, Oct. 17-21.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, Indianapolis, Ind., Oct. 9-12.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Milwaukee, Wis., Sept. 25-27.

AMERICAN WELDING SOCIETY, fall meeting, Detroit, Mich., Oct. 2-6.

HIGHWAY RESEARCH BOARD, National Research Council, Washington, D. C., Dec. 7-8.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, annual meeting, Milwaukee, Wis., Sept. 21-23.

INTERNATIONAL CITY MANAGERS ASSOCIATION, annual conference, International House, Chicago, Sept. 18-20.

NATIONAL SAFETY COUNCIL, 22nd Annual Safety Congress, Chicago, Oct. 2-6.

NATIONAL ASSOCIATION OF RAILWAY AND UTILITIES COMMISSIONERS, annual meeting, Cincinnati, Ohio, Oct. 10-12.

NEW ENGLAND WATER WORKS ASSOCIATION, annual convention, Bridgeport, Conn., Sept. 19-22.

NEW YORK SECTION, American Water Works Association, is to hold its annual fall meeting at Utica, N. Y. on Aug. 24 and 25. A special feature of the program will be the presentation of several papers and discussions on the National Industrial Recovery Act and its effect on waterworks extensions and improvement. At a recent meeting of the board of trustees the following were elected officers for the current year: Franklin C. Hopkins, chairman; R. K. Blanchard, secretary-treasurer, and F. G. Cunningham and W. F. Luby, trustees.

NOVA SCOTIA, NEW BRUNSWICK AND PRINCE EDWARD ISLAND BRANCHES of the Engineering Institute of Canada and the Nova Scotia Association of Professional Engineers held a joint convention at White Point Beach, Nova Scotia, on July 13, 14 and 15. Papers were read on the following subjects: Modern Practice in Highway Construction and Maintenance, by R. W. McColough; Supervisory Control, and Automatic Production as Applicable to Hydro Electric Development in the Maritime Provinces, by Howard Fellows; Use of the Back Pressure Turbine in a Modern Newsprint Mill, by J. H. M. Jones; Use of Pulverized Coal, by K. H. Marsh.

CENTRAL STATES SECTION, American Water Works Association, will hold its annual meeting at Grand Rapids, Mich., Sept. 21-22.

WISCONSIN SECTION, American Water Works Association, will hold its meeting at Milwaukee., Wis., on Sept. 25 to 27.

MINNESOTA SECTION, American Water Works Association, will hold its annual meeting at Minneapolis, Minn., on Oct. 19-20.

Water Works Committee Refutes Arguments Against Construction

A statement has been issued by the National Recovery Committee for Waterworks Construction, of the American Water Works Association, as to the duty of the communities of the nation to respond to the spirit of the National Industrial Recovery Act, and the advantages to those communities which do so respond.

The statement is in essence a detailed argument to meet the three types of opposition that have been observed in the various cities to taking advantage of the public-works section of the act. These three types of opposition have to do with the advisability of incurring indebtedness to undertake construction, the wisdom of the federal-grant feature of the act and doubt as to the extent of the benefits to be realized by the cooperating communities.

East St. Louis Extends Time For Track Rerouting

The city council of East St. Louis, Ill., has granted the Terminal Railroad Association of St. Louis a two-year extension of the time for the completion of the program of rerouting the railroads approaching the city from the East. The rerouting is to be in conjunction with the construction of a new Union Station in East St. Louis and additional railroad approaches to the St. Louis Municipal Bridge across the Mississippi River. The original ordinance, passed in 1930, provided that the work should be completed on July 30, 1933. This time is now extended to July 30, 1935.

Loan to Be Asked by Denver For Moffat Tunnel Water Project

A 5-million-dollar loan from Recovery Act funds, designed to complete the Moffat tunnel water diversion program in Denver, Colo., and to solve Denver's water problems for the next ten years has been proposed by the Denver water board. The board has stated that the program would give Denver 15,000 acre-ft. of water in direct flow and another 15,000 acre-ft. for exchange purposes. This amount, it is said, would remove all worry about water problems in Denver until the city has a population of 400,000.

The construction program outlined involves building of reservoirs, canals and tunnels. The estimated cost is $5,238,000.

Present plans of the water board include completion of the lining of the pioneer bore of the Moffat tunnel to carry 30,000 acre-ft. of water annually from the western side of the divide to the east. A shaft would be sunk at the west portal to carry the western slope water into the tunnel and force it over the high point. This shaft and the west half of the tunnel would be made capable of carrying 100,000 acre-ft. annually. At the east portal of the tunnel the water would be discharged into Boulder Creek, picked up near Eldorado Springs and carried through a tunnel skirting the foothills. When it reached Ralston Creek part of the water would be released for exchange purposes. The remainder would be piped directly into Denver. A filter plant would be built there which would purify the water for pumping directly into the mains.

Brief News

A KOREAN POWER DEVELOPMENT in which water now flowing into the Yellow River will be diverted through a mountain range to the Japan Sea was described recently to the Pacific Farm Congress at Vancouver by Dr. Motoji Shibusawa, of Tokyo Imperial University. By constructing reservoirs on the upper parts of rivers in Korea, a series of high-head power projects possible of developing 1,879,832 kw. is planned. The actual hydro development now in Korea totals only 165,644 kw.

THE METROPOLITAN SEWER COMMISSION, Providence, R. I., has retained Thomas H. Bowe and George W. Fuller of New York to complete a study of a proposed metropolitan sewerage system centering in Providence, Pawtucket, Central Falls, Cranston and Warwick. The commission voted to retain Stephen DeM. Gage, sanitary engineer of the Rhode Island Public Health Commission, to study pollution and sewage conditions in Narragansett Bay, the Providence and Seekonk Rivers and tributaries, with consideration of remedial possibilities.

CONSOLIDATED CONTROL and coordination of all local transportation facilities within the metropolitan district of London, England, has been effected by the recent passage of a law creating the London Passenger Transport Board, whose control includes the street railway (private and municipal), omnibus lines, electric and steam underground railways (with open air extensions), river steamers and suburban service of the main line railways. It appears likely that taxicab service will also be included. The Board of Control, headed by Lord Ashfield, will acquire, own and operate all the transport facilities except the main line railways, which will turn over to the Board their receipts from suburban traffic.

Contracts and Capital

CONSTRUCTION
(Thousands of Dollars)

	Weekly July 1932	Average Four Weeks	Week July 27, 1933
Federal Government	$11,176	$653	$725
State and municipal	11,949	5,855	5,075
Total public	$23,125	$6,508	$5,800
Total private	6,989	6,084	7,118
Week's total	$30,114	$12,592	$12,918
Cumulative to date:			
1932		$718,573	
1933		495,998	

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

	Weekly July 1932	Average Four Weeks	Week July 22, 1933
New capital issues	$19,000	$12,724	$8,101
Cumulative to date:			
1932		$477,000	
1933		183,351	

ENR Cost and Volume Index

E.N.-R. Cost		E.N.-R. Volume	
July, 1933	165.50	June, 1933	109
June, 1933	163.41	May, 1933	103
July, 1932	153.36	June, 1932	131
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average		100	

Personal Notes

HAROLD L. GEISSE, former president of the Wisconsin Valley Electric Co., has joined the operating staff of Byllesby Engineering & Management Corp. in Chicago.

EDWARD A. KEMMLER, formerly service director of Akron, Ohio, has been appointed resident engineer for Summit County, Ohio, in the state highway department.

FRANK T. SHEETS, former chief highway engineer for Illinois, has assumed the position of consulting engineer for the Portland Cement Association with headquarters in Chicago. For 12 years he had charge of the supervision of road construction in Illinois.

H. G. ROBY has been appointed chief hydraulic engineer of the Byllesby Engineering and Management Corp. to succeed J. W. Link, who has retired. Mr. Roby is a graduate of Dartmouth and of Thayer School of Civil Engineering and has been connected with the Byllesby organization since 1922.

J. W. LINK has retired from active service as chief hydraulic engineer of Byllesby Engineering and Management Corp. Mr. Link has been a member of the Byllesby organization since February, 1910. Among the important power projects which were developed under his direction are those at Cannon Falls and Rapidan, Minn.; Big Fork, Mont.; Albany, Oregon; Coon Rapids, Minn.; Ohio Falls power plant at Louisville; and Chippewa Falls, Wis.

L. D. CORNISH, chief engineer, Illinois State Division of Waterways has tendered (under request) his resignation effective July 15. He succeeded the late M. G. Barnes in 1928 and has been in the waterway department since 1919. Graduated from Syracuse University in 1902 he early became connected with the federal work on the design of the Panama Canal. He worked on the Canal Zone from 1907 to 1913 in charge of the design and construction of locks. Other engagements took him to China and improvement in the Ohio River. In the war he was in charge of construction in France and railroad work in the United States. Walter M. Smith, assistant chief engineer, has been appointed chief engineer.

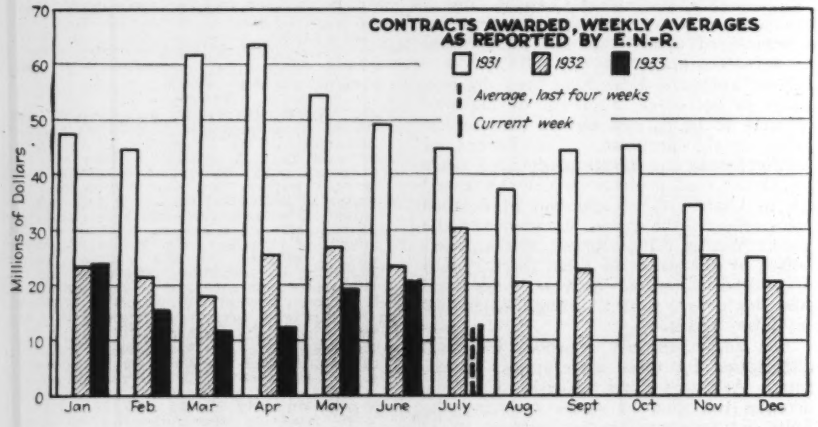
Obituary

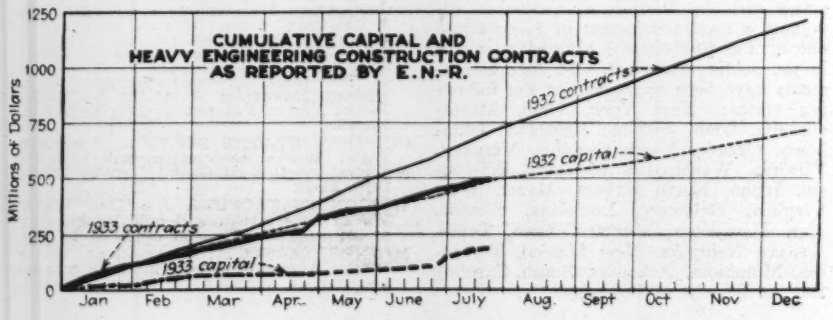
WILLIAM J. STILES, well known civil engineer of Richmond, Va., died in a hospital in that city on July 14, at the age of 76.

E. J. PEARSON, contractor of Memphis, Tenn., died on July 21 in a hospital in that city following an illness of two months. He was 61 years of age. Mr. Pearson had erected a number of buildings in the city of Memphis.

GEORGE W. BAXTER, head of the Western Construction Co., Evansville, Ind., died recently in a hospital in that city at the age of 53. He had suffered a paralytic stroke last February. He was born in Lafayette, Ind., and lived in that city for a number of years. He served two terms as county auditor and was defeated for the office of mayor before going to Evansville to live.

JOSEPH BRANSON, for several years a structural engineer in Chicago, died July 9 at the age of 52 in Monroe, La., from sunstroke. He was the inventor of a system of concrete forms bearing his name, also the Uni Tray system. His last invention was a precast gypsum joist system. At various times during the past ten years he was associated with Avery Brundage, Chicago contractor.

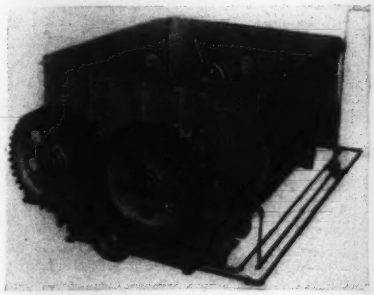




Construction Equipment and Materials

Pugmill Asphalt Mixer Permits Quick Discharge

The Barber Asphalt Co., 1600 Arch St., Philadelphia, Pa., has introduced a new asphalt mixer of 40 cu.ft. capacity. The new mixer is of the pugmill type, featuring a double slide and resulting larger opening which permits quicker discharge of material from the mixer. The slide gates are castings fitted with manganese steel liners and



New mixer by Barber Asphalt Co.

form the entire bottom of the mixer so that it presents a continuous regular surface. This assures a clean bottom, the manufacturer states, and prevents material from collecting at that point. One slide liner is longer than the other so that when the gates are closed the long liner extends partially over the other slide abutting the shorter liner and thereby preventing leakage at the center. The bolt holes in the liners are equally spaced to permit the liners to be interchanged and reversed in position.

New Highway Guard Uses Rotating Pipe

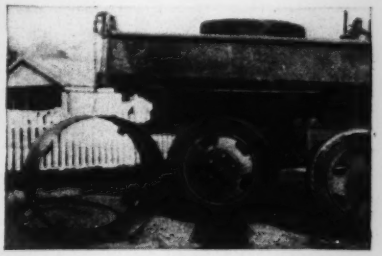
The Machined Steel Casting Co., Alliance, Ohio, announces its new rotary safety highway guard, designed to divert a car striking it back into the line of traffic. The installation consists of a horizontal pipe of 4-in. diameter, mounted on suitable bearings which permit it to rotate freely. When struck by the wheel of a car, which is rotating in a downward direction, this pipe is likewise set into an inwardly downward rotation, making it impossible for the wheel to climb over the guard, and diverting the car back into the regular line of travel.

Rotating-pipe highway guard.

The pipe is placed sufficiently low to preclude possibility of injury to fenders, bumpers, or body of the car. The only part that makes contact with the guard is the tire. The rotating pipe is furnished ordinarily in 6-ft. lengths.

Auxiliary Wheel Converts Truck into Light Roller

The New England Metal Culvert Co., 10 Alger St., Boston, Mass., has introduced the Lawrence auxiliary roller wheel, to be used in combination with a motor truck to provide a light road roller. The wheel consists of a wide steel band that fits over the rear wheels of a dual pneumatic truck, held in place by a series of flanges between the sets of tires. Both wheels may be equipped, or one wheel only, depending upon the work to be done.



Lawrence auxiliary roller wheel.

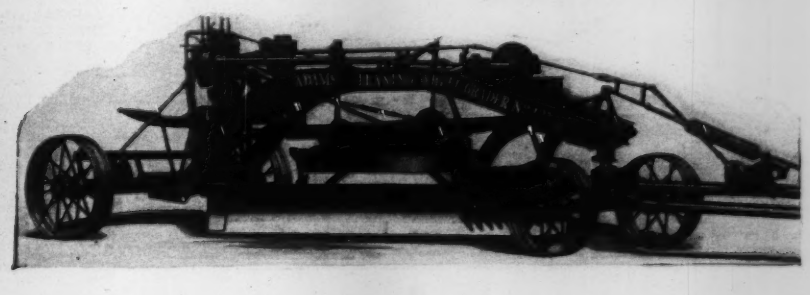
To install the auxiliary wheel the tires must be deflated, and the outside wheels removed. The auxiliary roller wheel is then slid over the deflated tire of the inside wheel, the outside wheel replaced, and both tires then inflated.

It is used in smoothing and compressing patches, rolling shoulders, and rolling and compressing of covering applied after seal coats of bitumen.

Leaning-Wheel Grader Now Has Power Control

J. D. Adams Co., Indianapolis, Ind., announces that the Adams leaning wheel grader No. 121, a heavy-duty construction machine, is now available with power-operated controls. Power for the controls is supplied by a 6 hp. single-cylinder air-cooled gasoline engine mounted in the grader frame. The power is transmitted from the engine to a control box immediately in front of the operator; here a series of heat-treated gears enclosed in a dirt-proof box and running on anti-friction bearings, transmits the power to the various control shafts. The control levers operate steel jaw clutches which release automatically when the extreme of any adjustment is reached. There is an independent lever for each adjustment.

Power-operated controls for Adams Grader



New Publications

Crawler Shovel. The Link-Belt Co., Chicago, Ill., has issued folder No. 1295 describing the Link-Belt K-48 crawler shovel-crane-dragline. The machine is arranged for gasoline, diesel-engine or electric-motor drive. As a shovel it is equipped with 25-ft. shovel boom, 17½-ft. dipper stick, and a 1¾-cu.yd. dipper, or a correspondingly larger dipper for lighter service. As a dragline it will handle a 1¾-cu.yd. heavy duty or 2-cu.yd. light-medium duty bucket on a 50-ft. boom. As a crane it has a rated capacity of 32 tons at 12 ft. radius and 10,400 lb. at 45 ft. radius on a 45 ft. boom.

Universal Cast-Iron Pipe. A new 56-page booklet featuring Universal cast-iron pipe and fittings has been published by the Central Foundry Co., 420 Lexington Ave., New York, N. Y. In addition to a description of Universal pipe, the booklet includes tables of dimensions and plates of straight pipe and special castings.

Concrete Pipe. The Universal Concrete Pipe Co., Columbus, Ohio, has published a 72-page pamphlet describing Universal concrete pipe for sewers and culverts. The booklet describes reinforced concrete pipe and how it is made and discusses in detail the applications that can be made with it. A great deal of tabular information is included as to strength and hydraulic capacities.

Tractor Equipment. The Caterpillar Tractor Co., Peoria, Ill., has recently published a number of catalogs describing tractor equipment. The publications include "Special Equipment for your Caterpillar Tractor," "Caterpillar Diesel Power Units," "Caterpillar Gasoline Power Units," and "Caterpillar Elevating Grader." Copies of any of these publications can be obtained from the company.

Link-Belt. A souvenir book has been published by the Link-Belt Co., Chicago, Ill., to be used in connection with the company's exhibit at the Chicago exposition. The book comprises 48 pages and illustrates and describes briefly the company's numerous products and the uses made of them by the Link-Belt Co.

Colloidal Graphite. The Acheson Oildag Co., Port Huron, Mich., has available for distribution Bulletin No. L102, which deals with the lubrication of small mechanical devices with colloidal graphite.

Truck Restrictions. "Truck and Trailer Size and Weight Restrictions" is the title of a handbook published by the Four Wheel Drive Auto Co., Clintonville, Wis. The size and weight regulations of the various states are condensed in tabular form. Truck and trailer combinations are listed in a separate table, giving the total gross loads permissible with each combination. The restrictions of each state are tabulated on separate pages.

Crushers. Bulletin 1469-C on Newhouse crushers is announced by Allis-Chalmers Manufacturing Co., Milwaukee, Wis. This new bulletin shows a revised table of capacities and describes the new and improved type dust seal developed for use on Allis-Chalmers Gyratory Crushers. Newhouse crushers are used mainly for secondary reduction in crushed stone, sand and gravel, mining and chemical plants.

Business Notes

R. B. WILSON, sales manager of the St. Louis plant of Joseph T. Ryerson & Son, Inc., has been made manager of the St. Louis plant of that company. Mr. Wilson has had long experience in the steel business, first becoming associated with the Ryerson Co. in Chicago.

JEFFREY MANUFACTURING CO., Columbus, Ohio, announces the addition of S. Leland Tolman to its engineering staff, Sanitary Division. From 1919 to 1932 Mr. Tolman was associated with the Sanitary District of Chicago, where for three years he was in full charge of the operation of the North Side Sewage Treatment Works. Prior to joining the Jeffrey organization Mr. Tolman was associated with the J. N. Chester Engineers, Pittsburgh, Pa.

CHAPMAN VALVE MANUFACTURING CO., of Indian Orchard, Mass., and the AUTOMATIC CONE VALVE CO., of Mattoon, Ill., have made an agreement whereby the Chapman Valve Manufacturing Co. has been given the exclusive right and license to the manufacture and sale of all products heretofore manufactured by the Automatic Cone Valve Co. The entire personnel of the Automatic Cone Valve Co. has been retained by the Chapman Valve Manufacturing Co. Mr. David D. Goldberg, previously general manager of the Automatic Cone Valve Co., will have direct charge of all cone valve sales work and engineering design at the home offices of the Chapman Valve Manufacturing Co., Indian Orchard, Mass.

Clutch-Type Excavators

The Marion Steam Shovel Co., Marion, Ohio, is adding to its line a complete series of clutch-type fully convertible excavators. These new Marion excavators are the straight-friction fully convertible type consisting of a primary power unit, either gas, diesel or a single electric motor connected through a master clutch and speed reducing mechanism, directly to the main machinery. Thus, the various functions of hoisting, traveling, swinging, crowding and booming are independently controlled through friction clutches.

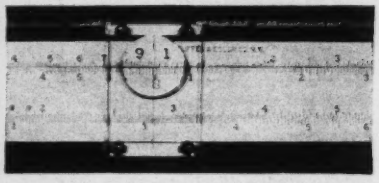
The crawlers are chain driven and particularly designed for full self cleaning to avoid clogging. Besides the two drive sprockets for each crawler, they are provided with intermediate rollers, one for each shoe to prevent the crawler belt from becoming tucked between them. These rollers are narrow and rounded to permit the shoe to tip sidewise to conform to the contour of the ground. All crawler bearings are sealed against dirt.

Marion excavators of straight-friction fully convertible type

Slide Rule Magnifier

A new type of slide rule magnifier is announced by the Slip-Lens Co., 15 Charlton St., New York City. The slip lens has a magnifying power of about two diameters. It attaches by suction and on account of its small size can be slipped from one scale to the other, always leaving one scale free for rough calculations.

Slip-Lens for slide-rule glass



Automatic Sluice Gate Maintains Constant Level

J. C. Stevens, of Stevens & Koon, consulting hydraulic engineers, Portland, Ore., has developed a new automatic sluice gate to maintain a constant level in a forebay, canal, or reservoir, by automatically discharging the surplus inflow.

The gate consists essentially of a leaf on two or more hangers hinged at the top to close an opening between piers. A seal is made on the two sides and bottom only, the gate leaf extending above operating water level. The gate carries a pair of tracks supporting a counterweight on sheaves that roll on the track. A link connects the counterweight shaft with a swivel on the pier. This link may be in the form of an L to avoid crossing the stream of outflowing water.

The gate remains closed against the water seal until the water rises to a predetermined level, whereupon the gate opens just enough to discharge the inflow causing the rise. As it opens the counterweight is pulled toward the gate. At the same time the track is inclined so that a portion of the weight is transferred to the pier through the link. By a proper adjustment of the weight, link, and its point of attachment to the pier, the gate may be made to remain in balance up to its full discharging capacity, and to automatically adjust its opening to any required discharge.

New Equipment in Brief

Concrete Placement Equipment. A new line of machines for pneumatic application of cement, concrete and refractory materials is announced by the Gunite Co., 1227 W. Beardsley Ave., Elkhart, Ind. The machines are used to apply pneumatically concrete and cement to structural steel; for coating or restoration of concrete, brick, tile or wood structures; waterproofing of basements and roofs; building thin walls; lining bunkers, reservoirs, etc.; in applying crushed fire brick, fire clay and other refractory materials to boiler fire boxes and building up arches; for cleaning buildings by wet sand blast; for general industrial plant repairs and many similar purposes.

Moistureproof Bags. A bag lined with moistureproof cellophane has been developed by the Rockland & Rockport Lime Corporation of Rockland, Maine, in which lime may be stored for a year or more without taking on moisture.

Air Filter. An entirely new model air filter, effecting a reduction in height and therefore requiring less headroom, is announced by the Independent Air Filter Co., 215 W. Ohio St., Chicago, Ill. The manufacturer states that this type is especially adapted for air compressors, diesel engines and a wide variety of small ventilating jobs. A weather hood can readily be attached for outdoor installations.

Tractors. The new model "K" tractor announced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., develops a maximum of 48 drawbar horsepower and has a top speed of 4½ miles per hour. At 2.08 miles per hour the tractor develops 8,750 drawbar pounds pull. The 15 in. tract shoes give a total of 2,010 sq.in. of track surface in contact with the ground. The tractor weighs about 11,000 lb., giving a ground pressure per sq.in. of 5.27 pounds.

Pump Mounting. Yeomans Bros. Co., Chicago, Ill., announces the new Jeffery vertical centrifugal pump mounting. The assembly comprises a Yeomans double roller bearing pump and a standard motor with ball bearings for vertical operation. Pump, motor and controller are mounted on heavy channel iron base at the factory and may be lowered into the pit and bolted to the wall. Where required, guide bearings are mounted on brackets on the base. The manufacturer states that the assembly allows the use of a small pump pit. The design is limited for the present to the Yeomans 8L6 and smaller pumps (3,000 g.p.m.).

Automatic Door Control. The Stanley Works, of New Britain, Conn., announces a method and mechanism for automatic door control and operation of industrial, commercial, transport or private doors. The operator is pneumatic and its control is through a light beam and photo-electric relay.

Diesel Engine. A new diesel engine, of Monovalve construction, is announced by the American Diesel Engine Co., Oakland, Calif. There is only one valve per cylinder. The new 4-cylinder engine operates at a rated speed of 1,200 r.p.m. and develops 75 hp. The manufacturer states that it is practicable to run the engine over a speed range from 200 to 2,000 r.p.m. giving a power range of from 35 hp. to 125 hp.